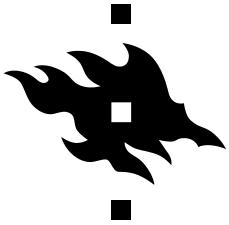

HELSINGIN YLIOPISTO

Citizens' perceptions on responsible innovations in forest bioeconomy

Master's Thesis

For the examination of Master of Science (Agr.&For.)

Forest Products Marketing and Management

Monika Vihakara

April 2019

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<tr><td colspan="3">Abstract
Strategic development in the forest sector has been slow and not until the 21st century stakeholder focus came as a part of the strategic development. New innovations are now having important role while renewing forest sector into bioeconomy. Corporate Social Responsibility (CSR)has traditionally been as a target for development in forest sector because of the high usage of natural resources, but from the 1990s it has gained more attention inspired by the global megatrends and now CSR can be seen as the base of the consept of bioeconomy. The study explored the citizen's perception towards forest sector innovation efforts from the year 2000 and within the next 20 years.

The results were drawn from an analysis of two data sets. Data one consisted of multivariate survey data based on 218 valid responses where current state of forest industry innovativeness was disclosed by using 13 bioeconomy products and services. Data two consisted of qualitative managerial interviews where forest industry professionals' opinions of forest industry contributions to sustainable innovations through the lens of three-dimensional innovation model/pyramid. Additionally, the aim was to get some reflections from survey results.

Concluding the results of this study, the public opinion of forest sector innovations seemed to focus on constructions related innovation efforts and biofuels. In addition, results showed that perceptions of material substitution with wood and reducing environmental impacts of industry were improved since year 2000. The image of future innovation targets of forest sector was quite wide and most heavily it was pointed towards wood building systems, construction materials, brand development and material substitution with wood. Statistically significant differences found between the "past" and "future" innovativeness inquire strengthening of both industry R & D and functioning of innovation systems.</td></tr>
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Tiivistelmä

Strateginen kehitys metsäsektorilla on ollut hidasta ja vasta 2000 –luvulla sidosryhmäkeskeisyys tuli osaksi strategista kehitystä. Tällä hetkellä uusilla innovaatioilla on tärkeä rooli metsäsektorin uudistamisessa kohti biotaloutta. Yritysvastuu on perinteisesti kehityksen keskiössä metsäsektorilla suuren luonnovarojen käytön takia, mutta 1990 –luvulla se saavutti lisää huomiota globaalien megatrendien myötä ja nyt yritysvastuu voidaan nähdä biotalouskäsitteen perustana. Tässä tutkimuksessa tutkittiin kansalaisten käsityksiä Metsäsektorin innovaatiopyrkimyksistä vuodesta 2000 sekä seuraavien 20 vuoden aikana.

Tulokset pohjautuvat kahteen dataan. Ensimmäinen data koostui kyselytutkimuksesta, joka pohjautui 218 vastaukseen, missä metsäsektorin innovatiivisuus tuotiin esille käyttämällä 13 biotalouden tuotetta ja palvelua. Toinen data koostui laadullisista yritysjohtajien haastatteluista, missä alan ammattilaisilta pyydettiin mielipiteitä metsäteollisuuden panostuksesta kestäviin innovaatioihin kolmiulotteisen innovaatiomallin avulla. Lisäksi tarkoituksena oli peilata kyselytutkimuksen tuloksia ammattilaisten näkemyksiin.

Tutkimuksen tuloksien mukaan yleinen mielipide metsäsektorin innovaatioista menneinä vuosina näytti keskittyvän rakentamiseen liittyviin innovaatiopyrkimyksiin sekä biopolttoaineisiin. Lisäksi tulokset osoittivat, että materiaalien korvaaminen puulla sekä metsäteollisuuden ympäristövaikutusten vähentäminen olivat parantuneet vuodesta 2000. Kuva tulevaisuuden innovaatiokohteista oli laaja, mutta eniten esiin nousi puurakentamisen ratkaisut, rakennusmateriaalit ja materiaalien korvaaminen puulla. Tilastollisesti merkittävät erot ”menneen” ja ”tulevaisuuden” innovatiivisuuden välillä antavat viitteitä tarpeesta vahvistaa sekä teollisuuden tuotekehityksen että innovaatiosysteemien toimivuutta.

Avainsanat – Nyckelord – Key words Metsäbiotalous, kestävä kehitys, innovaatiot	
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1 INTRODUCTION

Changes in the world and forest sector's mature product portfolio can be seen a driver for developing new innovations; many traditional forest sector products are maturing and losing its profitability and moreover, current global megatrends are reorganizing values and factors that are affecting to competitiveness. Urbanization, more people joining the global middle class, climate change and planetary boundaries are creating challenges for current businesses as well as possibilities for new business opportunities.

While trying to adapt to the change and transform traditional forest sector businesses into forest bioeconomy, it is important to understand how the citizens percept the sector and its innovation efforts. Societal expectations and perceptions towards forest sector are perhaps carrying the burden of the past and the public image of the sector itself can relate to old-fashioned industry (Creswell, 2013). According to Burns et al. (2016) understanding public opinions and working towards social acceptance is one of the key challenges faced by advancing bioeconomy concept.

Several studies promote corporate social responsibility (CSR) as an important driver for innovation (Nidumolu, Prahalad, & Rangaswami, 2009; Porter & Kramer, 2011). It is proposed that there is interaction between CSR and innovation, CSR is affecting to innovations and innovations are affecting to CSR outcomes. Hull and Rothenberg (2008), McWilliams and Siegel (2000) and Padgett and Galan (2009) argue in their studies about the positive correlation between CSR and innovation. In those studies it is underlined that positive effect of R&D intensity on CSR in not the same across different industries.

In the **context of the forest sector** the role of the innovations has been studied from the viewpoints of traditional forest industry and the new insights and value creation. Hansen (2010) has examined the role of innovations in the forest product industry by focusing on the current innovation research and providing an example of Finland's efforts to enhance innovation in forest products industry. Hansen, Juslin and Knowles (2007) have explored the concept of innovativeness from the perspective of

forest industry managers; how do they define innovative company and what challenges firms face as they attempt to become innovative, how they measure innovativeness and build innovative capacity. Van Horne, Frayret and Poulin (2006) argue that by improving the understanding of the concept of value creation from innovative knowledge, tools can be made to transfer the knowledge and to create effective value for the forest products industry. Rametsteiner, Weiss and Kubeczko (2005) suggest that innovation and entrepreneurship are main driving forces for economic growth, competitiveness and employment creation in Forestry in Central Europe. Weiss (2011) provide a short overview of the innovation research in European forestry focusing to the different factors that influence to innovation process including technological regimes, multiple actors, institutional frameworks and policy. Recently, Stern et al. (2018) studied perceptions on the forest sector innovativeness and mapped different innovations according to hype cycle perspective.

2 OBJECTIVES AND IMPLEMENTATION OF THE STUDY

The objective of this research is to build knowledge on the connection between corporate social responsibility (CSR) and innovations approached by two perspectives. First, by evaluating consumers perceptions of forest products companies' new products and business models from the viewpoint of sustainability, the aim is to find out whether citizens assimilate those sustainable and innovative or not. Second, by studying corporate managers reflections on citizen's perceptions, the intention is to get industry's professionals' feedback from the survey results and how they see forest industry contributions to sustainable innovations through the lens of three-dimensional innovation model/pyramid.

The main research questions of this study are:

1. How do citizens perceive the forest industry companies' innovativeness from the point of sustainability?
2. How do corporate managers see the industry contributions to sustainable innovations in comparison to citizens' perceptions?

Background of the study presents the history, typical features and the strategic development of the forest industry in Finland. People have different perceptions and usually those perceptions are formed based on the general knowledge and history, the current or the latest improvements or innovations thus may be hidden because of the "burden of the past". In order to understand perceptions regarding of the forest industry, it is important to understand how forest product industry has developed and why and what is the general knowledge regarding it. Corporate strategies and CSR strategies have changed through the time. Now global megatrends are affecting as a driving force to a sectorial strategic change towards the bioeconomy, which itself includes the idea of sustainability. On-going change from volume-based orientation to synergic value creation is closely related to bioeconomy and hence reasonable to be emphasized (Toppinen et al. 2016).

The theoretical part of the study is based on CSR literature, stakeholder theory and innovation theories, which are presented in chapter 4. First there are some theories

and discussion about the CSR; standardization, evolvement and few different approaches of the concept are on the focus. On the second part of the theory stakeholder theory and its definitions and categorization are put forth. Innovation theories and forest sector capability to innovate are on the focus on the third part of the theory.

Background of the study, consisting of a short overview of the sectorial evolvement emphasizing strategic and CSR changes towards sustainable bioeconomy because of the global megatrends, operate as a wider context whereas the CSR as a part of the stakeholder theory and innovations theories forms the framework of the study.

Empirical part of the study consists of two parts /data set. Data 1 was collected as an online survey and analysed using excel and SPSS software. The data analysis of the data 1 investigated public perceptions related to forest industry innovations in four European countries. Data 2 consisted of managerial interviews, where the results from data 1 were presented to forest sector professionals and asked to give reflective comments regarding the results and the state of the current innovation activities and CSR innovations in forest bioeconomy.

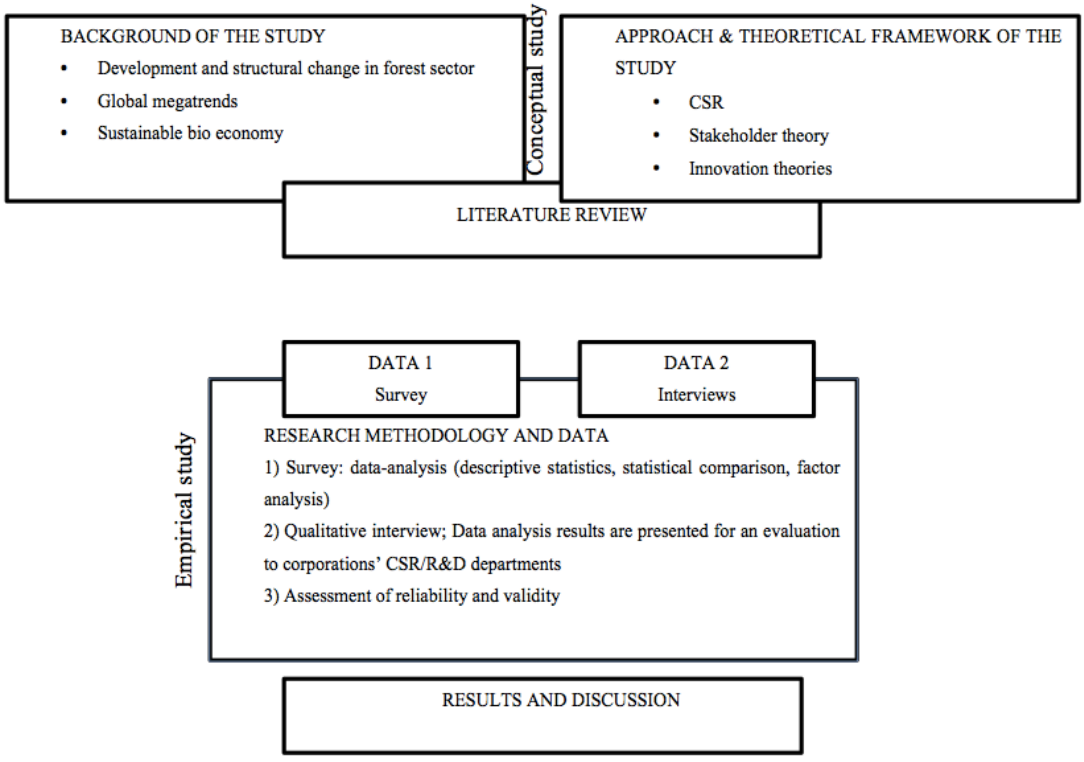

Figure 1 Study design

3 BACKGROUND OF THE STUDY

3.1 CREATIVE DESTRUCTION OF THE FOREST SECTOR

Finland's economic growth had been reclining strongly to the forest sector in the 20th century. Moreover, typically forest sector had been considered as a source of wellbeing of national economy and society and the conditions had been favourable for the forest sector and business in Finland. Traditionally the development of the forest sector had been quite horizontal because typically the enterprises had made several buyouts and fusions with the firms in a same industry. (Niskanen et al. 2008)

In general, forest sector had been known for its capital intensity and high use of natural resources. Production had based on bulk products, causing the high level of rivalry and sensitivity for economic trends. Politics, which had emphasized wood production led to efficient forestry and increasing wood production but simultaneously it narrowed nature's diversity and had made the industry's trade structure more one-sided. Forest industry's institutions had developed from the basis of wood production, which deepened the unilateralism of the trade structure and schematics of the development (Niskanen et al. 2008). Capital intensity and mature product range in forest sector caused unfavourable development in its profitability, and the only solution to it is to reform (Uronen, 2010) and hence discover new business opportunities.

Since the 1980s, the focus was on the magazine paper production and severe problems appeared at the beginning of the 21st century when several concurrent factors impacted negatively to magazine paper's productions and competitiveness in Finland. US dollar weakening, paper demand declining because of the information technology and digitalization and rapid paper production increase in Asia led to paper production overcapacity and poor profitability in Europe. (Niskanen et al. 2008, Uronen 2010) Decrease in profitability was especially caused the fact that increased manufacturing costs could not be added into the end products price because of the overcapacity of the sector (Uronen, 2010).

According to Hetemäki et al. (2011) the background and reasons of the ongoing rupture besides the value changes regarding the forests and forest utilization have been since the early 2000s:

1. Globalization and "China –syndrome"
2. Development of digital information systems
3. Refining production based on planting forests
4. Climatic and environmental changes and related global political commitments
5. Questions about energy demand
6. Developed countries turning into the service-driven economy

The development described above has led to (a) strategic change(s), which has affected to forest companies' stakeholders and that is why the CSR is seen more essential. The role of society and information has increased along the rupture of the forest sector, simultaneously forcing it to reconsider, evaluate and direct its attention to new strategies and development possibilities. From figure 2 it can be seen the point of the rupture at the turning point of the 21st century.

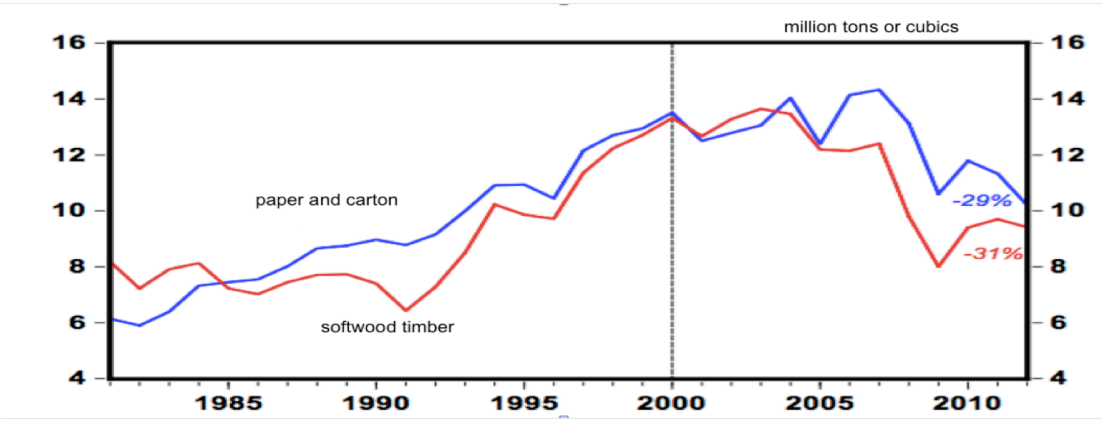

Figure 2 Structural changes in forest sector (modified from Hetemäki, 2012)

3.2 STRATEGIC EVALUATION AND DEVELOPMENT IN FOREST SECTOR

According to Juslin and Hansen (2002) the demands that society has been posing to forest industr traditionally focused on mitigating the environmental impacts caused by operations. Environmental focused requirements have changed through time and six different periods have been identified:

1. 1970s – water- and climate pollutions
2. Mid 1980s – recycling and usage of recycled fibres
3. Late 1980s – cassation of chlorine bleaching
4. Early 1990s – forestry and sustainable forest management
5. Mid 1990s – forest certification
6. 21st century – climate change and forests impact on that

In the 21st century forest sector has faced claims about paying attention to employees and surrounding society besides environmental issues. Increasing pressure for approving social responsibility is mostly a result from that the forest companies have shut down factories and moved their production to countries where the costs are smaller. (Juslin & Hansen, 2002)

Strategic development in the forest sector has been slow, and initially strategies baseline was on the production orientation. In the 1980s strategic focus turned towards markets and customers thus generating the rise of global investments. Not until the 21st century stakeholder focus came as a part of the strategic development and in addition other stakeholders' than just customers interests and values were taken into consideration. Currently service-driven strategies are commonly adduced in the theoretical discussion regarding about the forest sector but it is important to observe that yet there is no empirical evidences. From figure 3 can be seen the strategic evaluation of forest sector. (Toppinen et al. 2013)

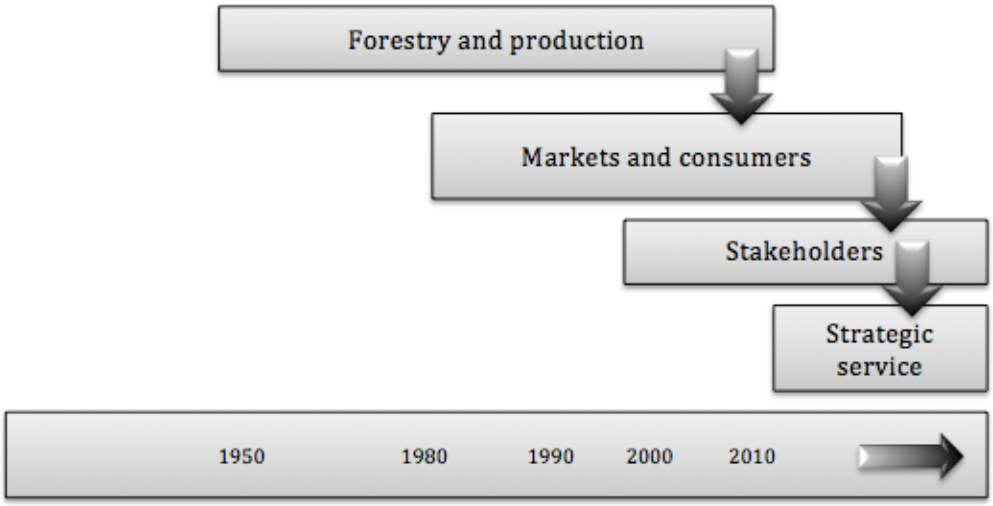

Figure 3 Strategic evolution/orientation in the forest industry (modified from Toppinen et al. 2013)

Through the strategic evolvement and forest sector's rupture the sector's orientation has developed from forestry and production orientation towards focus on stakeholders. Though considering CSR has previously been as a target for development because of the high usage of natural resources, from the 1990s it has gained more attention inspired by the global megatrends. Expanding to greater geographigal area because of the cheaper labor force and raw materials has engendered sosio-economical inpacts, which has, for example, raised the discussion about layoffs. Changes in the area of operation have forced forest companies to consider about the economical and social factors along with ecological factors. (Toppinen et al. 2013) As a result of extensive global forest product businessess, the environmental and socio-cultural effects are in a global scale important, regardless of whether the company is acting globally or not. (Lähtinen & Myllyviita, 2014).

The changes described above have placed the CSR strategies under re-evaluation, when executed. Within the last decade there has been a change in the relationship with CSR and the development of company strategies: nowadays, CSR is not seen as a disconnected part of the strategy, instead it needs to be aligned with the business strategies. When reading forest sector companies' websites, many of them are currently communicating that the CSR is considered more as a change and a strategy than a practice defined by the strategy. Emphasises in conducting CSR can be seen tied into the time, business and corporate; according to Toppinen, Lähtinen & Holo-

painen (2015) perceptions and implementing the CSR are related to context, especially the size and the operating area of the company are emphasised.

3.3 GLOBAL MEGATRENDS AS A DRIVER FOR NEW STRATEGIES

Pätäri, Tuppura, Toppinen & Korhonen (2015) (see e.g. KPMG, 2012) identified ten megaforces of CSR and sustainable development, which have affects to business. These megaforces are: urbanization, population growth, water scarcity, wealth, food security, material resource scarcity, climate change, energy and fuel, deforestation and ecosystem decline. Previous forces and trends are affecting to business evolvement through new regulations, physical and weather related phenomenon, price increase and volatility, changes in consumer preferences, resource constraints on production. With the help of these trends and development paths it can be recognized the threats and possibilities forest sector business and CSR may encounter. Anticipating the future and change management are fundamental issues because moving towards new business strategies crates uncertainty and engender challenges to industry's companies. Future external and internal threats and possibilities should be recognized both local and global level.

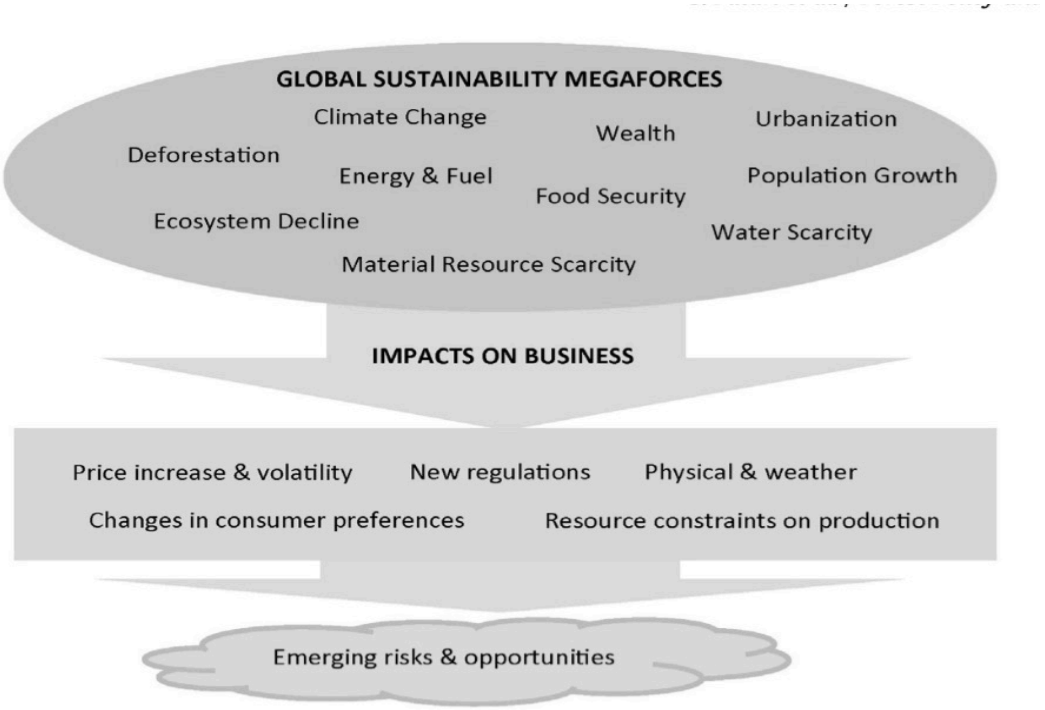

Figure 4 Global sustainability megaforces and impacts on business according to Pätäri et al. 2015

According to FAO report (2011) currently and in the future forest sector is impacted by several different factors. Positive external opportunities can be found from changes in demographics in low and middle-income countries, economic growth, globalization and social trends for example. Positive internal forces and strengths are connected to innovation possibilities of forest sector, environmental features of forest products and adaptability and management of raw material supply. Negative external forces are demographics in high-income countries, competing materials, competition for resources and changes in forest control and management. Internal negative forces and weaknesses are its existing industry structure, labour costs and working conditions, maturity of existing product markets, social and environmental performance and perceptions. (FAO, 2011)

Global megatrends are affecting forest products companies and their business opportunities, restrictions and challenges. Responding to these challenges and striking into new possibilities requires new way of thinking and creation of new business models. Reacting to the megaforces requires re-evaluating and re-directing the business which can be seen from the strategic orientations changes towards bioeconomy in forest sector companies.

3.4 THE TRANSITION TOWARDS BIOECONOMY

According to Haberberg & Rieple (2008) branches of an industry have four similar lifecycle phases from the perspective of diffusion of products in the market. The first stage is the market **entry** when there yet is not many customers and the technology strains the market entry of new companies. At this point usually products are expensive, unit cost is high and product range is small. The second stage is **growth**; new rivals are trying to enter the markets, product range is increasing and unit costs start to decrease. **Maturity** is the third stage, then products quality is excellent, profits are high and cost of units is low. The fourth and the final stage is **decline**, when the customers are leaving, product range starts to shrink and industry suffers from overcapacity and decreasing profits.

According to Hansen (2016) an industry's life cycle affects to its innovativeness. At the beginning of the cycle product innovations are at the focus, after that the focus moves towards to the process innovation until it also subsides. The fact that forest sector companies have a traditional business culture and they operate in a mature industry where high volume production and process innovations are usually on the focus causes challenges to forest sector transition to the bioeconomy (Hansen, 2016).

Besides industry's structure, development is affected by macro environment's political, economic, social, technological, legal and environmental factors as well as globalization. Reflecting forest industry at the context of Haberberg & Rieple's (2008) theory, it can be noticed that the forest industry is trying to reborn after the decline and companies are now changing strategies and forest product company brand towards bioeconomy. For example new slogans like "UPM – the biofore company", "Stora Enso –rethink" and "Stora Enso – the renewable materials company" can be considered as sings of strategic change and declaring of a new self-identity. Despite of political instability, many forest products companies are openly pronouncing their strategic change towards bio-based companies (Toppinen et al. 2013).

Firm-level CSR relates closely to forest industry and it could be seen as a source of bioeconomy thus defining the concept is important. Finland's council of state has declared a bioeconomy strategy where it is defined as an economy, which uses renewable natural resources for food, energy, products and service production. Preventing ecosystems from impoverishment, reducing dependency on fossil fuels and natural resources, advancing economic growth and creating new jobs with the principles of sustainable development are pursued. Efficient use of natural resources and promoting recycling and closing the loops are essential. Bioeconomy is generated around the versatile benefits of using renewable natural resources. (European commission, 2012, Sitra 2013).

From strategic point of view, bioeconomy can be seen as sustainability related concept, which can help to solve current problems regarding to climate change, increasing rivalry of natural resources or developing regional welfare. Bioeconomy as a new societal order/institution is challenging the current practices and structures because it

can be considered to be local as well as global. Refining local solutions for example to energy production, the base can be made for the global solutions. (Sitra, 2013)

According to Hetemäki, Niinistö, Seppälä and Uusivuori (2011) bioeconomy can be defined as a production in different sectors and also as a production, which is surpassing the sector boundaries. There are applications for bioeconomy in branches of energy-, forest-, chemical-, pharmaceutical and food industry. Within the last few years forest sector has recognized the new possibilities that bioeconomy engenders and obviously reacted to that with redirecting their strategies towards it. In general, bioeconomy has become popular and fashionable concept and often it is used to generate interest and create new, positive impression. It is necessary to study more about the concept because the usage of different concepts and models are reflecting to our thoughts and actions. (Hetemäki et al. 2011) Understanding public opinions and working towards social acceptance is according to Burns et al. (2016) one of the key challenges faced by advancing bioeconomy concept.

4 THEORETICAL BACKGROUND OF THE STUDY

4.1 VIEWS ON CORPORATE SOCIAL RESPONSIBILITY

The concept of Corporate Social Responsibility (CSR) is developing and the discussion regarding the topic is constantly escalating both in media and in academic debate. The importance of CSR has increased simultaneously with the partial decline in the societal capability to maintain the social welfare along with the globalization (Halme & Laurila, 2009).

CSR as a topic is rather wide due to the multiple definitions, viewpoints and existence of parallel concepts. Even though the number of researches of the topic is so plentiful, none of the definitions has become established and as well the consensus of the concept lacks (Dahlsrud, 2008; Lindgreen & Swaen, 2010).Terms such as corporate social responsibility, corporate citizenship, (corporate) sustainability and corporate citizenship are commonly used when referred to CSR. Great amount of parallel definitions may occur because of the questions concerning the responsibility and its boundaries, motives and the implementations of CSR are ambiguous and often bound to time and culture. Cultural and geographical differences are explanatory factors for lack of coherent perception of what is sustainable activity. (Mikkilä, 2006) Additionally Lenssen et al.(2006) are explaining the multidimensionality of the concept with the view that because the concept of CSR combines the business with society and because societies are culturally, societally and nationally different, additionally the perceptions of the CSR differs. In this text the concept CSR is used to cover the definitions mentioned above.

In 2001 European commission defined CSR as a concept, where corporations voluntarily take social and environmental concerns as a part of their business and stakeholder operations. Concepts such as voluntarity, stakeholders, social responsibility, economic responsibility and environmental responsibility exist almost all of CSR standardizing studies made regarding CSR conceptualizing. (Dahlsrud, 2008)

According to Panwar and Hansen (2007), despite many definitions, CSR simply means that corporation is balancing issues concerning its' **social, economic and en-**

vironmental responsibility. Companies' operations create social and economic advantages for society by employing citizens, generating money flows and tax incomes for community and in addition, creating value by means of production and delivery. (Barrett, 2009)

There are many concepts concerning of CSR but probably one of the most well-known is John Elkington's **Triple Bottom Line**, which was published in 1997. The concept consists of "the three Ps": People, Planet and Profit and its core idea is to describe how CSR is compounded of three different viewpoints. **"People"** is referring to social activity and operations, **"Planet"** to environmental actions and **"Profit"** to economic operations and functions. Social activity includes things such as employees' wellbeing, stakeholder relationships, fair trade, policies and procedures in business networks for example. Things like waste management, land use and resource efficiency among other things are on the focus in environmental actions. Economic operations and functions cover things like pursuing profit, money flow effects to public economy and optimizing costs.

Porter and Kramer (2011) have suggested that the concept of **Shared Value (CSV)** should be taken instead or at least beside CSR because traditional CSR policies are indefinite and disconnected to business and thus difficult to justify and maintain in a long run. When operating along Shared Value both profitability and competitiveness of the company are accelerated, and same time societal value is generated. There are no contradictions between societal needs and corporates' economical ambitions; instead they are bounded to each other. For example resource scarcity forces to resource efficiency, which decrease costs and simultaneously contribute sustainable development (Porter & Kramer, 2011). Porter and Kramer (2007, 2011) consider that the societal integration and shared value is better because when the CSR is built into a corporate strategy it can help corporates to integrate itself to stakeholders' interests and thus enable shared value and competitive advantage without extra inputs or costs.

According to Krause, Vachon & Klasse (2009) a corporation is as responsible as its suppliers from whom it is purchasing its services and raw materials. Because of that, for multinational (and globally operating) corporations the responsibility is quite

often seen to comprehend their whole supply chains. This approach to responsibility brings challenges to both operational and strategic actions. The width of the CSR has got criticism; the most famous contradiction towards the wide concept of CSR is Milton Friedman's thought that the primary and only responsibility and meaning of a corporate is to maximize its profits.

Halme and Laurila (2009) are approaching CSR from three different angles: **philanthropy, integration and innovation** (see Figure 5). The angle depends on how a corporate is implementing CSR. The way that CSR is implemented effects to the results, also to economic ones. Consequently what kind of CSR is related to what kind of economic and social results in what kind of circumstances should be considered.

According to Halme and Laurila (2009) **Philanthropy** as a form of CSR is the least integrated with the core business and therefore it does not engender much profit to the company. According to Hillman and Keim (2001) philanthropy actions, which are not related to primary stakeholders are negatively related with shareholder value and moreover, philanthropic actions are easy for competitors to copy and thus competitive advantage cannot be gained through charity actions.

Corporate responsibility **integration**'s focus is to integrate CSR into the core business, for example ambitions such as fulfilling primary stakeholders expectations like product quality or using responsible supply chains. Integrated CSR do not necessarily generate huge profits to the company but it can for example help with reputation control or create cost savings. Halme and Laurila, 2009) Schaltegger & Wagner (2011) argue that if sustainability management transforms into sustainable entrepreneurship, it pulls the whole market towards sustainability and influences the society as a whole because with innovations/sustainable solutions for mass markets, they are able to influence on society.

According to Bocken at al. (2013) business model innovation seems to be a key to delivering future sustainability and it could be done by using value mapping as a primary step in a business modelling process for embedding sustainability into the core purpose of the firm and its network of stakeholders. Porter and Kramer (2006)

argues that by identifying important societal concerns and creating business solutions for those, it is possible to create new sustainable arisen business, which gives a company sustainable competitive advantage. When the CSR is approached through the **innovation**, the relation between the CSR actions and the core business of the company is more than integrated to the core business. In fact, CSR innovation can be considered as an extension of the core business. CSR innovation is created when the source of an innovation, and thus new business opportunity, is some societal or environmental problem and the company refine a new product or a new service, which solves the problem. Then, contrary to charity/philanthropy, there can be so called win-win situation. When the level of integration rises towards innovation, also the level of potential economic and social benefits increases. Greatest competitive advantage can be gained when the CSR is extended over the core business, and environment friendly, resource efficient, responsible innovation with added value can be generated. However, it is important to remember that corporates usually use some type of CSR portfolio, which consists of several different forms of CSR (Halme & Laurila, 2009).

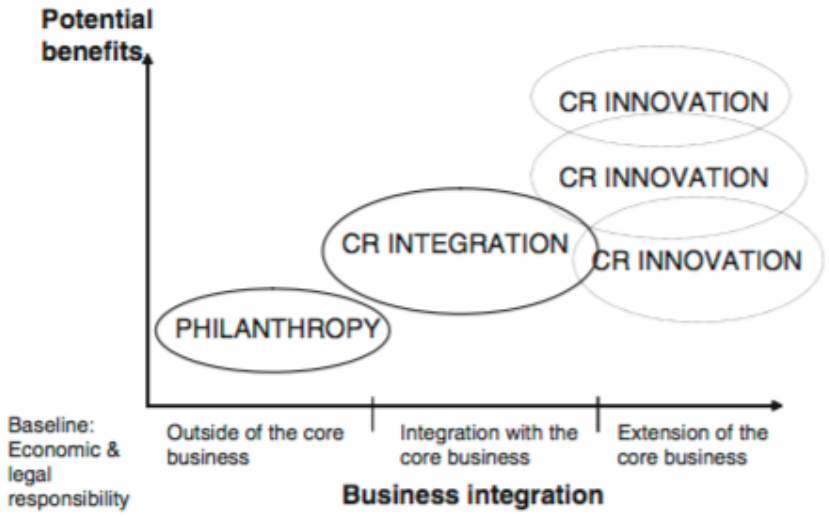

Figure 5 Level of business integration of corporate responsibility and the potential benefits (Halme & Laurila, 2009)

4.2 STAKEHOLDER THEORY

Stakeholder theory in commonly used to define relationship between CSR and society. However, there are different opinions and perceptions about that who are the stakeholders of the company, what is the organisations role in the society and how different stakeholders are connected to each other. Different stakeholders and stakeholder groups are creating pressure and obligations towards companies; some of the stakeholders have larger impact and meaning for example to the company's strategies, operations, business implementation and profit engendering. It is interesting to think what, where and even when those stakeholders are the company's stakeholders and can they be defined or categorized somehow.

Frequently Freeman's (1984) definition where "a stakeholder is any group or individual who can affect or is affected by the achievement of the firm's objectives", is emerged when reading studies made of stakeholder theories. Somewhat there are even broader definitions to stakeholders: Carroll (1989) propounds that the stakeholders are "any individuals or groups who can affect or are affected by the actions, decisions, policies, practices or goals of an organization". Both previous definitions are quite wide and do not deeply consider the type of interaction between the company and its stakeholders. There are several classifications of different stakeholder groups but next in this text there will be presented only few most used ones.

Stakeholders can be classified into **internal** and **external** stakeholders. Internal stakeholders are those to whom company's actions are affected instantaneously; they usually are connected to the business directly - thus owners, managers, employees and shareholders can be categorized into that group. External stakeholders are not involved with the company with the same intensity and thus there is not same kind of strong dependency among stakeholders of the group compared to internal stakeholders. On a contrary, external stakeholders - such as customers, suppliers, media, investors, and competitors – have the possibility to affect negatively or positively to the company's opportunities and threats. (Mark-Herbert and von Schantz 2007)

According to Carroll (1989) stakeholders can be also divided into **primary** and **secondary** stakeholders; those, who have official or contractual relationship with the firm are primary stakeholders and all others belong to the secondary stakeholders. Primary stakeholders can be considered more crucial to the firm's business and survival than secondary ones. Secondary stakeholders do have an impact on a company but not so severe because they are not committed in transactions with the company. Hence, the key difference is the level of the engagement between the stakeholders. Though it is important to recognize the power of the secondary stakeholders; for instance media or non-governmental organizations can cause damage to the company for example by affecting to its reputation. (Clarkson 1995, Niskala et al. 2013).

Donaldson and Preston (1995) suggest that there are three viewpoints of the stakeholder theory; it can be **descriptive, instrumental and normative**. Those different angles can be used as a tool for recognizing which are the most essential stakeholder groups, what are their needs and wants and what kind of structures there are used to manage stakeholder relationships in the organization. Descriptive angle explains the stakeholder management as it emerges in the organization. Instrumental stakeholder theory explains the relationship between the stakeholder management and the success of the company. Normative stakeholder theory is used as a base to stakeholder policies in order to steer the operations of the company. According to Steurer (2006) the classification should be even deeper and suggest that stakeholder theory aspects should be considered not only from a corporate perspective but stakeholder and conceptual perspective as well. **Stakeholder perspective** is interested of how the stakeholders are trying to influence to the company. **Conceptual perspective** is interested how to a single matter or problem can be affected through the stakeholder relationships.

Stakeholder engagement and dialogue with stakeholder's aims to find out what social and environmental issues are considered to be most important about company's performance so that decision-making and accountability can be improved to respond to stakeholders' expectations. According to Widén, Olander and Atkin (2014) the nature of stakeholders' engagement can avail or hinder attempts at innovation. For identified key stakeholders should be made an explicit plan for communication and engagement in order for successful innovation and diffusion. Sloan

(2009) argues that collaborating with stakeholders can lead to learning, innovation and fundamental corporate transformation.

4.3 INNOVATION THEORIES

As a result of broadness of the concept of innovation, it is often mixed with the term invention but they are not exactly the same thing. Mayers and Marquis (1969) have defined innovation as "*not a single action but a total process of interrelated sub processes. It is not the conception of a new idea, nor the invention of a new device, nor the development of a new market. The process is all these things acting in an integrated fashion*". According to Rogers (1995) "*innovation is an idea, practice or object that is perceived as by an individual or other unit of adoption. It matters little, so far as human behaviour is concerned, whether or not an idea is 'objectively' new as a measured by the lapse of time since its first use or discovery*". Different authors often distinguish innovation from invention by suggesting that an invention is an idea but an innovation is inventions' commercial and practical application. Hereby the following equation can be formed to illustrate the relationship between innovation and invention; "Innovation = theoretical conception + technical invention + commercial exploitation". (Trott 2008)

According to Kotler (2002) innovation can be defined as "an idea, service, product or technology that has been developed and marketed to customers who perceive it as novel or new". Moreover, Kotler emphasizes that innovation is a process, where novel product or service values are identified, created and delivered in the market place. In addition, innovation and innovativeness can be understood as different things: innovation is about to create something new and innovativeness is about to create some new characteristics (Han, 2010). Knowles, Hansen and Shook (2008) define innovativeness as "the propensity of firms to create and/or adopt new products, manufacturing processes, and business systems". Levitt (2004) talks about so called marketing myopia in the context of innovations; a sector can assume themselves to be in some business, it is only the mater of an aspect. For example, railroads serve as an example of an industry whose failure to grow happened because of a limited market view. The railroad industry is failing because it is more product orientat-

ed than customer orientated; they have assumed themselves to be in the railroad business rather than in the transportation business.

Weiss, Ollonqvist and Slee (2010) are classifying innovations into the following types:

1. **Product innovations** are innovations, which are new or significantly improved goods or services. Functional characters, user friendliness, incorporated software, components and materials, technical specifications are included in improvements.
2. **Process innovations** are new or significantly improved production or logistic/delivery methods. Changes in techniques, equipment or software are included in improvements.
3. **Marketing innovations** are new marketing methods including significant changes in product design or packaging, product placement, product promotion or pricing.
4. **Organizational innovations** consist of new organizational methods in a firm's business practices, workplace organization or external relations.
5. **Institutional innovations** mean changes in the political-institutional framework of the sector. Market actors alone cannot necessarily do implementation of novelties; instead those are dependent on changes in the policy field or procedures.

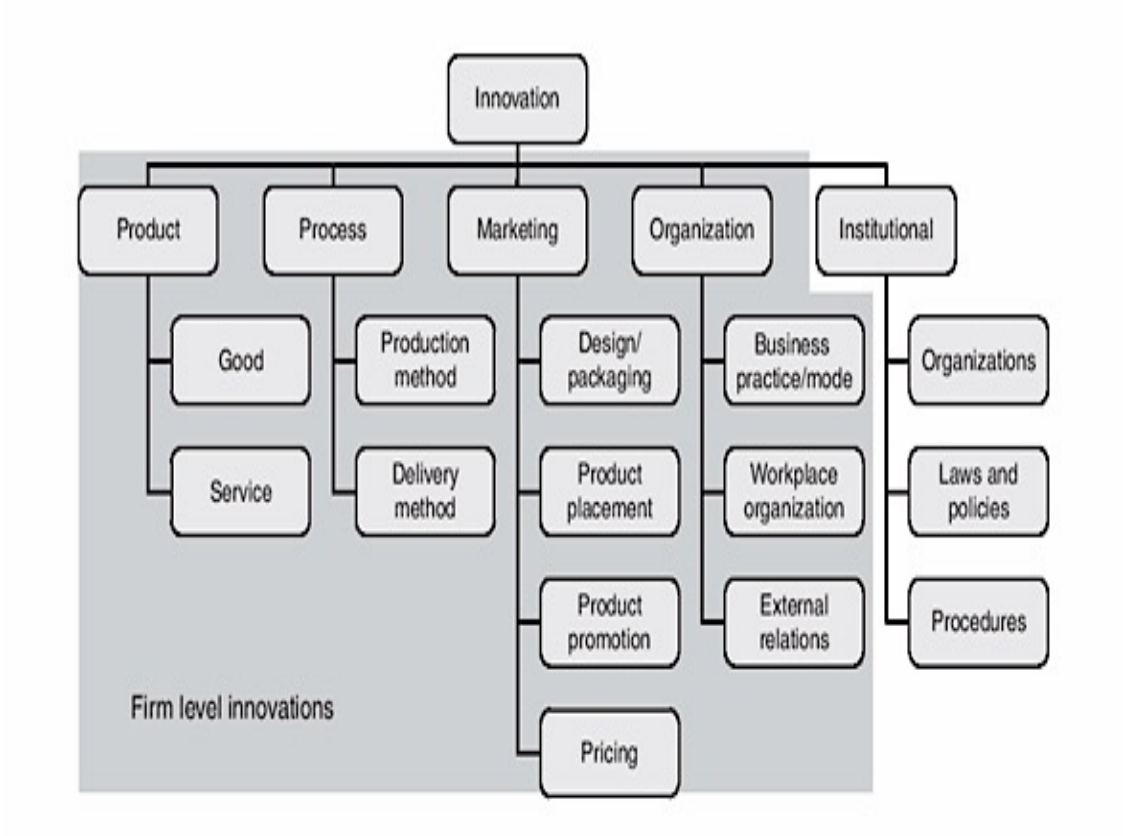

Figure 6 Types of innovation (Weiss et al., 2010)

Trott (2008) classifies the innovations into seven different types and thus there are few more types compared to Weiss' innovation classification. Trott categorize production innovation as its own type of innovation, also product and service innovations are individualised:

Typology of innovations	
Type of innovation	*Example*
Product innovation	The development of a new or improved product
Process innovation	The development of a manufacturing process
Organizational innovation	A new venture division; a new internal communication system
Management innovation	TQM (total quality management); BPR (business process re-engineering; introduction of SAP/R3)
Product innovation	Quality circles; just-in-time (JIT) manufacturing system; new production planning software, e.g. MRP II; new inspection
Commercial/Marketing innovation	New financiing arrangements; new sales approach, e.g. direct marketing
Service innovation	Internet-based financial services

Figure 7 Typology of innovations (Trott, 2008)

Rogers (1995) points out the difference between diffusion and adoption of an innovation. **Diffusion** describes the percent of adoption on an innovation in the markets and **adoption** describes the decision of an individual organization to start using the inno-

vation in its business. The context and social system (individuals, informal and formal groups, organizations and subsystems) affects to the diffusion of innovations because they are affecting to it through communication structure, networks, norms and opinion leaders. According to Frambach and Schillewaert (2002) a conceptual framework of organizational innovation adaption consist or supplier marketing efforts (targeting, communication, risk reduction), social network (interconnectedness/network participation), environmental influences (network externalities, competitive pressures), which affects to perceived innovation characteristics. Together with characteristics at the organizational level (size, structure and innovativeness) those contribute to adoption decision of an organization. Individual innovation acceptance in organizations is related on organizational facilitators/internal marketing (training, social persuasion, organizational support) and personal characteristics (demographics, tenure, product experience, personal values) together with social usage (network externalities and peer usage).

Individuals perceive (and thus prefer) differently characteristics of innovations, which causes that innovations are adopted at different time and at different rate. Perceived relative advantage, compatibility, complexity, trialability and observability are parts of adoption process of an innovation. (Rogers, 1995) According to Trott (2008) diffusion is basically consumer willingness to embrace change, which is driven by the benefit they expect to derive from the new products, services or solutions.

According to Hansen and Juslin (2011) there are four major trends in **forest industries**, which are affecting to the innovations:

1. Restructuring and search for profitability
2. Cost reduction through product optimisation and technological innovations
3. Customer orientation and thus differentiation and adding value to the products are on the focus
4. Solutions to environmental challenges

Typically large companies in forest sector tend to be more innovative than small ones, probably because of the access and availability of resources and co-operation helps to create better conditions to innovations and product/process refining. Process

innovations are commonly in the focus at large companies, where as in small companies usually have more balanced innovation portfolio. (Hansen, 2011)

Forest sector's capability to innovate depends on the innovation system of the sector and the internal strategic decisions, capacity etc. within the companies. According to Rametsteiner, Weiss and Kubeczko (2005) there are different matters in the system, which are affecting to the possibility to innovate. Markets and demand for forest products are depended on consumers (final demand) and producers (intermediate demand) and that affects to the production system (final products, intermediary products, primary products and the producing companies), which is connected to forest resources/raw material and suppliers. Also infrastructure (banking, innovation and business support etc), political system (government, governance, RTD policies, policies etc) and the framework conditions (financial environment, mobility, propensity to innovation and entrepreneurship) affects to education system, research system and again to production system.

Vargo & Lusch (2008) argue that all partners of change are value (co) producers. Thus, the public perceptions of forest sector innovativeness not only measure the "image" of the sector but also how much the end-user has been exposed to new innovative efforts of the sector itself. Creswell (2013) suggests that human beings construct meanings as they engage with the world they are interpreting based on their historical and social culture and experiences. Consequently, forest products end-users may assimilate the sector based on historical knowledge instead of the new, innovative efforts.

5 RESEARCH METHODS AND DATA

In this study innovations in forest bioeconomy were approached from the viewpoint of value-added pyramid (Figure 8) and innovation opportunities are categorized into three groups: products, sustainable process/ production innovations and services or business models. The bottom segment of the pyramid consists of incremental improvements in traditional pulp, paper and wood products and wood based bioenergy. The middle section is characterized with more value-added components, which could be advanced biofuels, biomaterials, composites or from organizational innovations

point of view developing new marketing channels, service enhancements or reduction of environmental impacts. The top of the pyramid then includes high-value added, niche products such as highly sophisticated system solutions (for example in the new tall wood buildings), fine chemicals or nanocellulose. Nanocellulose is due to its high versatility perhaps the most interesting new niche material discussed under the umbrella of forest bioeconomy.

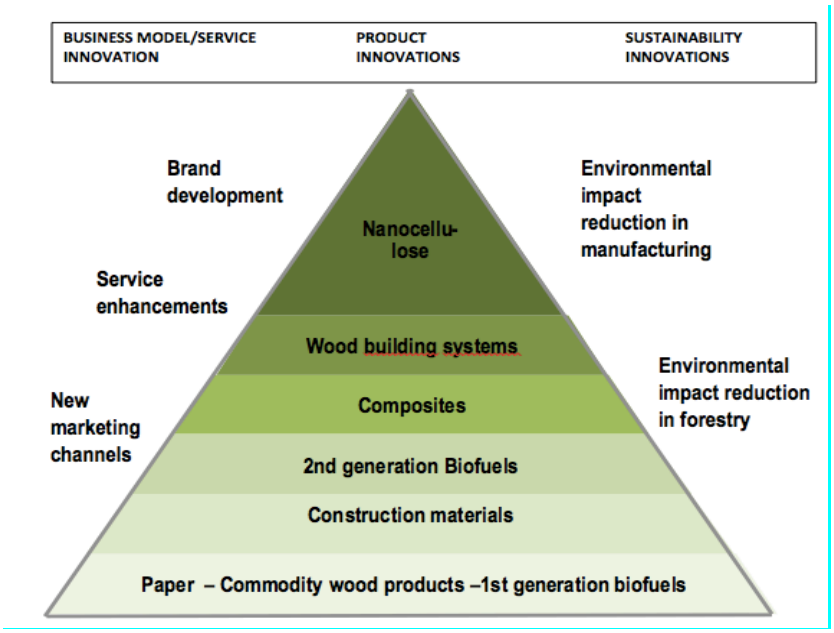

Figure 8, Classification of forest bioeconomy-related innovations using a value pyramid

5.1 POPULATION OF THE STUDY AND DATA COLLECTION

The objective was approached through an empirical data analysis, which examines citizens' perceptions of wood related products and services. The following chapter describe materials and chosen methods for the present thesis. The multivariate data set of this study has two parts.

The first part of the data set was drawn from the W3B –**Survey**, which was developed within a European research project based on both innovation literature and practical knowledge on forest sector. The data gathering was implemented during May–September 2015, targeting respondents in four forestry rich European countries (Austria, Finland, Germany, and Slovenia). The link to the survey was promoted via e-mail (e.g., professional e-mail lists, including different forest stakeholder repre-

sentatives and students), social media, and online forums with the purpose of reaching both people involved and not involved in the forest sector.

The first part of the data set was composed of one specific Module of the Survey, where respondents were asked for their views on how a) forest sector has contributed to innovations since year 2000 and b) how it will contribute to these innovations in the next 15 years. A five-point Likert -scale (1 = strongly disagree, 3 = undecided, 5 = strongly agree), including an additional "I don't know" option, was used. The questionnaire was also pre-tested prior to implementation of actual data gathering. In each of the four countries, a pre-test was conducted in April 2015 (n = 20) to make sure the questions could be understood, and based on it, some changes were made to the questionnaire. In addition to inquiring about an extensive list of various potential areas of innovations, questions about the socio-demographic characteristics of the respondents were also included in the survey e.g., age, gender, education, residential area, employment status, and involvement in the forest sector through formal education, profession or forest-ownership (see Appendix 1). Altogether 218 valid responses were received from the Survey where current state of forest industry innovativeness was disclosed by using 13 bioeconomy products and services. In addition it was gauged whether the respondent perceptions would reflect active engagement by the forest industry to tackle new forming business models of bioeconomy.

The second part of the data set was collected through **managerial interviews**. These interviews were conducted face to face in forest product companies in order to have forest product industry's professionals' reflective opinions about the results regarding the first data set about citizens' perceptions of forest bioeconomy innovativeness. The aim was to have some suggestions what could be the factors affecting the perceptions and how do the companies' themselves see they have accomplished to inform about their bioeconomy related strategies. Interviews were conducted using a semi-structured interview guide. The interviewees were approached via email (interviewee selection based on the relevant position the interviewee was in the company, e.g. innovation related tasks and/or sustainability relating aspects) and asked voluntarily to participate to the research. Cover letter and theme question frame including the relevant results from the W3B Survey were provided via email after/if the person accepted to participate to the research and was able to give an interview (see Appen-

dix 2). The interview requests were emailed to four persons but only two of them were able give an interview. The interviews' duration ranged from 54 to 57 minutes and they were recorded with the permission of the interviewees. Both interviews were conducted on the 8th of December 2016.

The interview questions and the question frame were designed after conducting the literature review and receiving the results from statistical data analysis from the survey. As a result of this phase, five main themes and with specified (sub)questions were identified. The first three themes were about **reflecting the survey research results**, the fourth theme was around **innovation activities in the ecosystems of bioeconomy** and the fifth theme treated **corporate social responsibility as a part of innovation activities**. The objective of the first theme was to get feedback and opinions about the categorization that had been made for the wood based innovations. The second theme aimed to have more specific opinions about the categorization of innovations and what categorizations could be the most important and the least important within the next 15 years in forest bioeconomy. The third theme aimed to have managers' opinions of which are the innovations that should be invested in and were there something surprising in the public opinion. The object of the fourth theme was about to establish deeper insights about the innovation activity in forest sector including questions regarding the roles of different participants, the drivers and challenges for the evolvement and the changes in the markets. The fifth theme aimed to have some suggestions of what is the correlation between innovation activity and corporate social responsibility.

According to Koskinen et al. (2005) theme interviewing is simple form of interaction and it consists of interviewer's questions and interviewee's answers, which usually are narrative. The most relevant instrument that leads the interview is the interview frame. Firstly, it ensures that a researcher asks all the necessary questions and secondly, it supports the interview situation so that it goes as natural as possible. With the help of question frame, it is possible to understand the logic of the interview and additionally it makes easier to control the time that can be used in each question. (Koskinen et al. 2005) By using qualitative theme interviewing as a research method, it was possible to discover manager's viewpoints and analyses regarding the innovativeness in forest companies.

5.2 DATA ANALYSIS

The first part of the data analysis composed the quantitative part of the study based on W3B –Survey approaching the public perceptions on wood based innovations. At his phase of the analysis, W3B Survey data were entered to the SPSS program and then the values were inspected and only relevant data were preserved. In the second phase, variables were labelled/renamed into more appropriate form. Four age groups were formed in order to have comprehensive results and after the data was organised, it was reasonable to conduct descriptive statistics; tables and direct distributions of the respondents' background (sex, area of living, age). The data were analysed using descriptive statistics, t-tests, factor analysis and analysis of variance. For an extraction method it was reasonable to choose Principal axis factoring (PAF) because it identifies the latent constructs behind the observations, whereas principal component identifies similar group of variables (Bishop et al. 2007). By excluding the items that had low loadings or cross-loaded, the factor solution was tested.

With SPSS the wood-based innovations/actual questions in the survey were regrouped into three dimensions of innovations according to the value-added pyramid (Figure 8) in order to see which of them is perceived innovative. Exploratory factor analysis was used to analyse dimensionality of respondents' perceptions of the forest sector innovativeness, i.e. whether we can find logical connections between product, service and sustainability related innovations.

The second part of the data analysis were related to qualitative data gathered through managerial interviews aiming to have some reflections and forest professional opinions regarding the survey results. In addition, as possible causes of different perceptions regarding wood based innovations are difficult to discover with surveying and quantitative analysis, it was reasonable to conduct qualitative analysis with the help of people working with the sector and wood based innovations. The purpose of the managerial interviews was to get feedback of the survey results and get suggestions of the reasons that are affecting the public perceptions of wood based innovations; the qualitative analysis of the managerial interviews is kept primarily qualitative and identifies themes, patterns and situations. The content analysis in this case focused

on latent content and thus single words and terms were not investigated, but instead the interviews were interpreted as what the interviewee aimed to say with words and terms. This study utilizes inductive approach to content analysis as the research moves from specific to general by examining the content of the samples without seizing theories (Elo & Kyngäs, 2008). In addition, deductive approach (from general to single sample) is used as the theory about interaction between CSR and core business is raised up and analysed from innovation perspective (Tuomi & Sarajärvi 2002, 95-99).

The data were condensed into categories and applying colour codes to interview transcripts, it was possible to examine emerging themes, similarities and differences. Tables, from which it was possible to identify central issues raising up from the interviews, helped identify themes raising up from the interviews. (Saaranen-Kauppinen & Puusniekka, 2009). Coding/theme categories in qualitative content analysis should be as homogenous as possible but unlike in qualitative analysis, it is possible to assign a unit of text under to more than one theme simultaneously (Elo & Kyngäs, 2008, Zhang & Wildemuth 2016, Weber 1990).

This study utilized triangulation as it combines both qualitative and quantitative approaches, and hence it can be categorized as mixed methods research. According to Tuomi & Sarajärvi (2002, 142-143) triangulation can be categorized to four main types:

- **Triangulation of material** - one research combines several different materials (interviews, statistics, achieves, different object of information
- **Triangulation of researchers** - multiple researcher investigates the same phenomenon and are involved in some part of the research or the whole research process
- **Triangulation of theories** – multiple theories are used when interpreting the research material
- **Triangulation of methods** – multiple data gathering methods are used when collecting the research data

List can be extended with analysis triangulation if more than one analysis methods is used, and multiple triangulation if several triangulation types are used. According to

Johnson et al. (2007) triangulation have several benefits: researchers can be more self-assured regarding their results, creative data collection methods can be developed, data collected can be more abundant, theories can be integrated, contradictions can be found, competing theories can be disputed because of the comprehensive perspective. Investigators, who use mixed methods in their research aims to provide the best understanding of a research problem (Creswell, 2013).

5.3 RELIABILITY AND VALIDITY

According to Saaranen-Kauppinen & Puusniekka (2009), (see also Kirk and Miller, 1986, 41-42) there are three different sections in **reliability**: quixotic reliability, diachronic reliability and synchronic reliability. The method used should be trustworthy and consistent in those circumstances, for example in some cases (e.g. delicate topics) stereotypic or socially acceptable answers should be under evaluation whether they are reliable or not. Research observations should be enduring regardless time, though it may be problematic because usually in qualitative research objects rarely are invariable. Results should be consistent with different instruments used at the same time, usually researcher have to struggle with this because often results do vary (Creswell, 2013). Kondracki et al. (2002) suggests that accuracy is the most important part of reliability because the quality of classification can be observed.

Koskinen et al. (2005) argues that reliability measures the level of consistency when some cases are placed into same category by different observers at different time – the results should be consistent and there are four aspects in reliability. Firstly, congruence can be shown with different indicators, which are measuring the same thing, for example using statistics and interviews for confirming the observations congruence. Second, accuracy of the instrument is used for measuring the observation fidelity of the frequent phenomenon, for example same question can be asked several times in different forms. Third, objectivity of the instrument tests how do others understand the observer's meaning, and by using several observers, who investigates the same object, can ensure it. Fourth, continuance of the phenomenon relates to observation's continuous similarity and the aim is to make sure that phenomenon is not unique by making observations in different time. (Koskinen et al, 2005).

Validity can be understood how intensively some argument, interpretation or result express the target it was aiming at. Validity can be categorized into internal and external validity. Internal validity signifies how consistent and logical the interpretation is, and external validity means is it possible to generalize the interpretation into other cases beyond what was researched. The aim of validity examination is to prevent situation were something that is considered to be true or false is not that. There are several situations how incorrect perceptions can be deduced and researched should be able to indicate that his/her results do not based on for example wrong questions at the interview or observations made from atypical situation. In addition, results should be able to generalise in other cases or at least the probabilities of biases should be noticed/ recognized (Koskinen et al 2005). Naturalistic research practises consider traceability as the most important concept of reliability in a research. Research and research methods should be traceable at least in four different dimensions: reliability, portability, dependency, and conformability. (Koskinen et al., 2005, Lincoln and Guba, 1985)

According to Whittemore et al. (2001) there are primary and secondary validity criteria in qualitative research. Authors argue that credibility, authenticity, criticality, and integrity are considered as primary validity criteria; those are necessary to qualitative inquiry but by themselves they are not sufficient. Secondary validity criteria pertain explicitness, vividness, creativity, thoroughness, congruence and sensitivity provide more flexible benchmarks of quality and can be applied to particular investigations. In differing investigations techniques contribute to validity and explains specific validity criteria - it is essential not only to claim what we know but also how it is claimed.

While estimating the reliability of this work, it is important to consider that the analysis was based on the researcher's suggestions and interpretations where values, history, knowledge and background influences on how the results are understood and categorized. Presenting precise narrative on used methods and phases of the study advances the reliability of this work. Congruence was improved with triangulation: by using statistics from survey and managerial interviews it was tested whether the observations were substantiate. By using several observers and triangulation of researchers objectivity was tested and continuance of the results was evaluated in man-

agerial interviews. The survey measured perceptions regarding past and future forest sector innovation efforts, from where it could be studied are there sustainability emphasises found, which was the aim of the first research question. Another researcher could theoretically conduct a similar analysis, so the requirement of accuracy is fulfilled. However, the small sample size and biased sampling compared to population of the countries limits the generalization of results of the survey. Regarding validity of this work, there are points that should be taken into consideration. The respondents of the survey had higher than average forest sector involvement and managers of the interviews hold diverse positions in their organization, which affected that some of the provided answers were not fully coherent or was emphasized from their particular field of expertise and thus not answered fully to the question. It is good to remember that speaking or writing can be ambiguous even if the questions are carefully formatted.

6 RESULTS

6.1 CITIZENS' PERCEPTIONS ON FOREST BIOECONOMY SUSTAINABLE INNOVATIVENESS

The first target of the study was to examine citizen perceptions regarding forest industry's innovativeness from the point of sustainability. According to the results, respondents had strongest consensus that forest industry has since year 2000 produced innovations for wood building systems, construction materials, biofuels, material substitution with wood and composites. The lowest image of innovativeness since year 2000 was perceived to be associated with organizational side: development of new marketing channels and recognized brands.

Wood construction related to innovation efforts, such as construction material, wood building systems, material substitution with wood, was perceived to be the most important for the next 20 years and forest industry should continue to focus on that above others. The development and innovation efforts regarding wood-based biofuels and paper products gained least support.

Regarding nanocellulose, 43.1% of the respondents were incapable of evaluating past innovation activity and 33.9% of the respondents were incapable of evaluating future innovation activity, which indicates lack of public awareness.

The following figures 9 and 11 presents first the direct distributions of the actual questions (see appendix 1) and respondent reactions to them. Figures 10 and 12 are presented for identifying which variables has similar values or if there are any outliers amongst each variable. After this we dive into analysing the latent structure of the responses to reflect on the previously presented model of innovation.

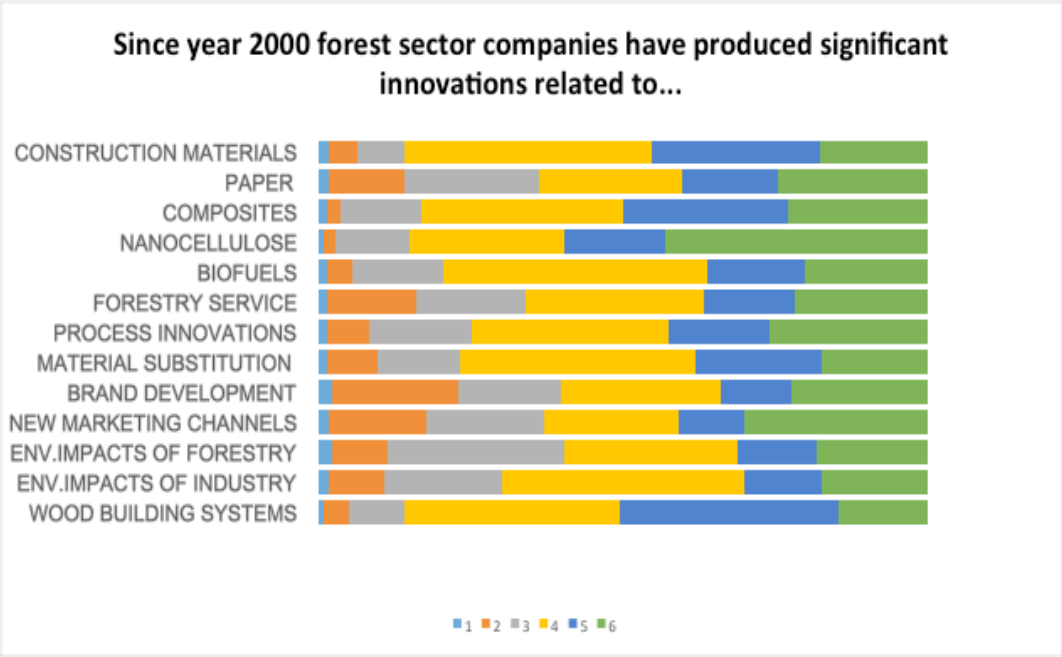

Figure 9 Perceived forest sector companies' capability to innovate from year 2000 (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree, 6=I don't know)

Figure 9 shows the distribution of perceived forest sector companies' capability to innovate from year 2000. It can be seen from the radar chart (see figure 10) that nanocellulose and new marketing channels had the sharpest peaks in "I don't know" answers, which implies the unawareness of those in the context of forest sector. Radar chart also shows that there were considerable amount of "strongly agree" answers regarding the capability to innovate in wood building systems from year 2000. Construction materials, biofuels, material substitution with wood and reducing environmental impact of forest industry variables had high values in "agree" answers.

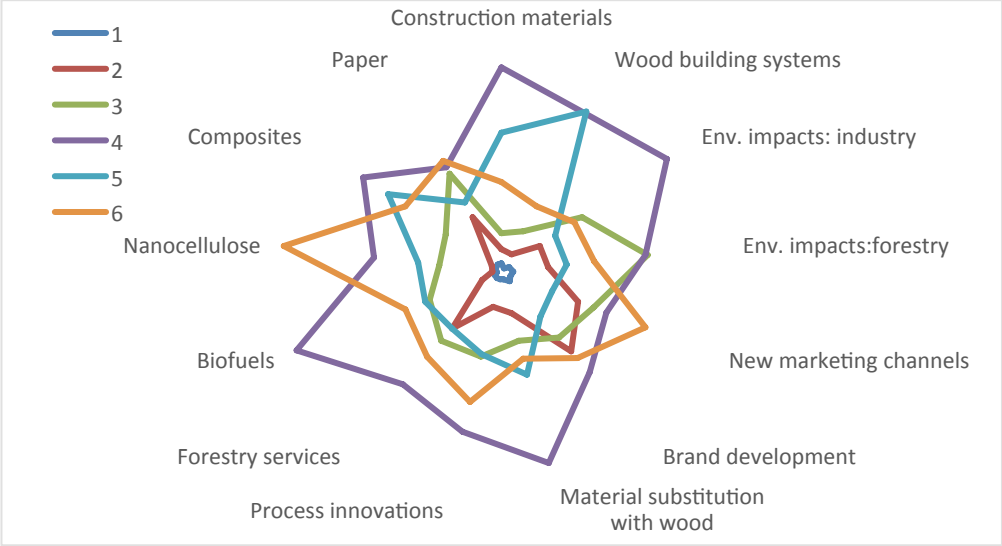

Figure 10 Perceived forest sector companies' capability to innovate from year 2000 (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree, 6=I don't know)

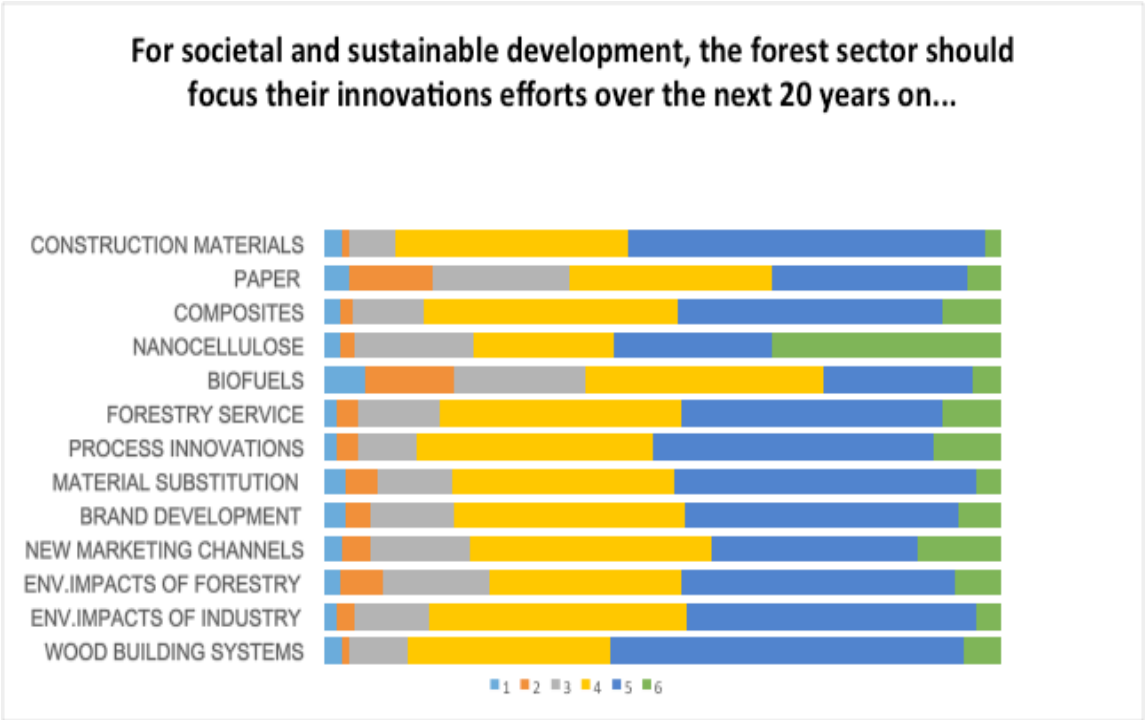

Figure 11 Forest sector should focus innovation efforts over the next 20 years on (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree, 6=I don't know)

Figure 11 implies the perceptions regarding on what forest sector should focus innovation efforts over the next 20 years on. The variables in this radar chart (see figure 12) have softer peaks when compared to variables of past innovation efforts. Howev-

er, construction materials, wood building systems and material substitution with wood were perceived to have potential and worth innovation efforts in the future as ”strongly agree” had larger values. Accordingly, “strongly agree” had higher values in many variables and thus the line forms wider area compared to radar chart of the perceptions on past innovation efforts. Subsequently, when comparing the radar charts of perceived future innovation efforts and past innovation efforts, there were significant changes as in perceptions towards future innovation efforts had low values in “I don’t know” answers and the “strongly agree” answers had higher values in many variables.

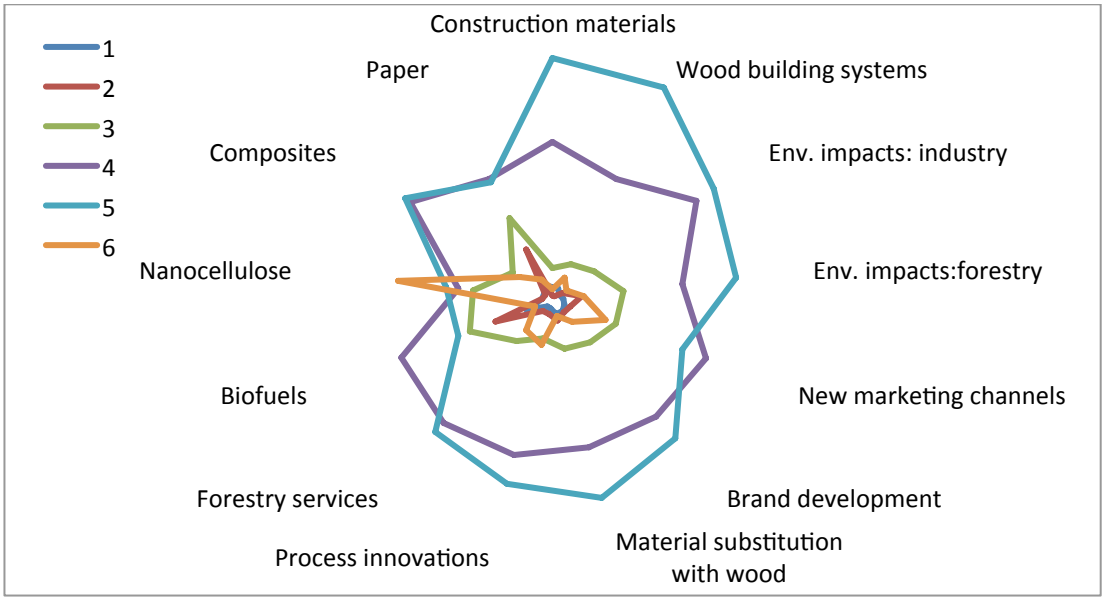

Figure 12 Forest sector should focus innovation efforts over the next 20 years on (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree, 6=I don’t know)

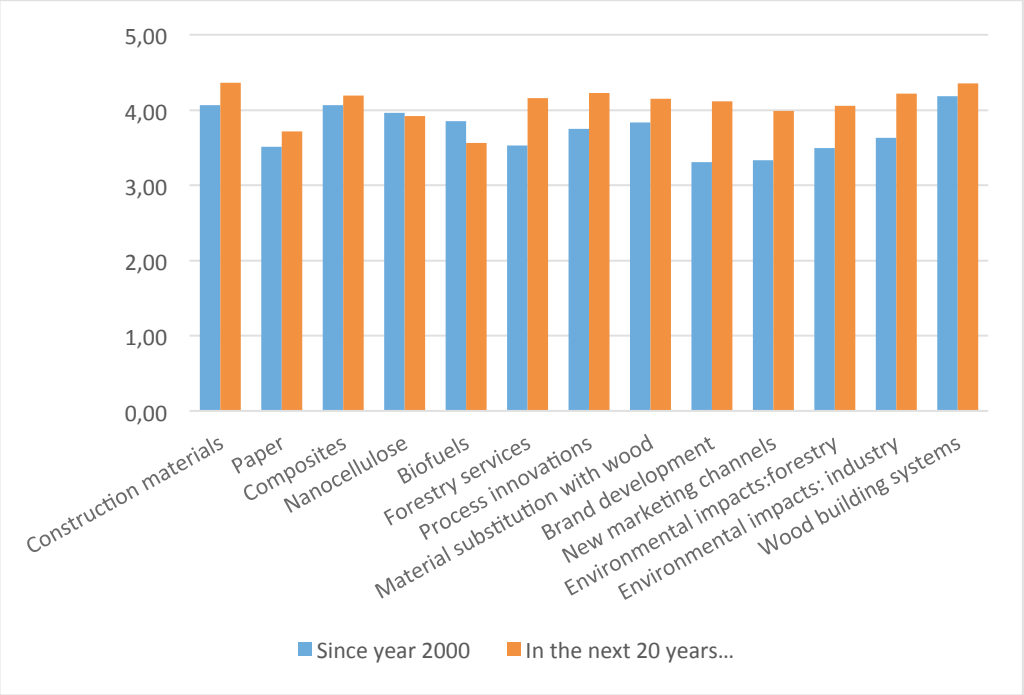

Figure 13 Forest sector produce significant innovations related to (since year 2000/In the next 20 years)

The following tables display the background of the respondents.

Table 1 Sex

	Frequency	Percent
Female	98	45
Male	108	49.5
Total	206	94.5

Altogether 206 respondents out of 218 had indicated their sex in the Survey form. Among 206 respondents, 98 (45%) were females and 108 (49.5%) male.

Table 2 Area of living

	Frequency	Percent
City or urban area	113	51.8
Suburban area	26	11..9
Rural area	73	33.5
Total	212	97.2

In the Survey form 212 respondents out of 218 had indicated their area of living. Among 212 respondents, 113 (51.8%) were living in city or urban area, 26 (11.9%) were living in suburban area, and 73 (33.5%) were living in rural area.

Table 3 General Age Groups

	Frequency	Percent
below 20 years	23	10.6
21-41 years	112	51.4
42-62 years	58	26.6
over 63 years	25	11.5
Total	218	100

	Frequency	Percent
below 20 years	23	10,6
21-41 years	112	51,4
42-62 years	58	26,6
over 63 years	25	11,5
Total	218	100

In the Survey form all 218 respondents had indicated their age. Among the respondents, 23 (10.6%) were below 20 years, 112 (51.4%) were 21-41 years old, 58 (26.6%) were 42-62 years old and 25 (11.5%) were over 63 years old.

Answers regarding future innovation efforts were not normally distributed so this part of data was not used in further analysis. Answers regarding past innovations were quite well normally distributed, so next the hypothesis of three dimensional innovation approaches was tested. Hence, a picture of the nature of respondents' perceptions of forest sector innovativeness was built via explanatory factor analysis by analyzing the multidimensional nature and loadings of the past innovation measurement scale. Some of the items had high number of "I don't know" answers and in order to conduct factor analysis, it was necessary to code those as missing values.

Table 4 Descriptive statistics

Descriptive Statistics							
	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Std. Error
Past construction materials	179	4.06	0.93	0.86	-1.24	0.18	0.36
Past paper products	164	3.51	1.07	1.15	-0.23	0.19	0.38

Past composites	168	4.07	0.90	0.80	-0.99	0.19	0.37
Past_nanocellulose	124	3.96	0.89	0.79	-0.77	0.22	0.43
Past biofuels	174	3.86	0.86	0.74	-0.88	0.18	0.37
Past service enhance-ments	170	3.53	1.06	1.12	-0.31	0.19	0.37
Past production process	161	3.75	0.97	0.94	-0.61	0.19	0.38
Past material substitution with wood	180	3.83	0.97	0.94	-0.77	0.18	0.36
Past brand development	169	3.31	1.11	1.23	-0.10	0.19	0.37
Past new marketing channels	152	3.34	1.07	1.15	-0.09	0.20	0.39
Past reducing environ-mental impacts of forest-ry	178	3.49	0.98	0.96	-0.29	0.18	0.36
Past reducing environ-mental impacts of manu-facturing	180	3.63	0.95	0.90	-0.63	0.18	0.36
Past building systems with wood	186	4.18	0.89	0.79	-1.16	0.18	0.36
Valid N (listwise)	91						

In the factor analysis, similar variables are grouped into dimensions to identify latent variables. According to factor analysis results, paper products, production process, material substitution with wood and building systems with wood had low loadings on the PAF –solution, which means that those questions of bio-economy innovativeness did not seem to separate respondents' perceptions from one another. Thus, low loading items were moved from the analysis to discover a clear picture of the model behind the items measuring forest sector innovativeness. The following displays the key descriptive figures of the acquired factor solution.

Table 5 Communalities

Communalities		
	Initial	Extraction
past_construction materials	0.53	0.63
past_composites	0.48	0.55
past_nanocellulose	0.47	0.56
past_biofuels	0.35	0.38
past_service enhancements	0.42	0.45
past_brand development	0.52	0.53
past_new marketing channels	0.52	0.85
past_reducing environmental impacts of forestry	0.50	0.65

past_reducing environmental impacts of manu-facturing	0.49	0.68
Extraction Method: Principal Axis Factoring.		

The communalities display good levels of variance extracted as they indicate the proportion of each variable's variance that can be explained by the retained factors. The sensitivity analysis of this group of scale items produces three-dimensional solution.

Kaiser-Meyes-Olkin Measure of Sampling Adequacy (KMO) and Bertlett's Test of Sphericity tests together should be passed before a factor analysis is reasonable to conduct. KMO varies between 0 and 1; values close to 1 are advisable. Bartlett's Test of Sphericity test the null hypothesis that the correlation matrix is an identity matrix and it should be rejected. In this case the values support the factor analysis for selected items.

Table 6 KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.808
Bartlett's Test of Sphericity	Approx. Chi-Square	330.681
	df	36
	Sig.	.000

The values in Rotation Sums of Squared loadings represent the distribution of the variance after the Varimax rotation, which tries to maximize the variance of each of the factors; the third row shows that the first three factors account for 58.54% of the total variance.

Table 7 Total Variance Explained

Total Variance Explained									
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Va-riance	Cumulative %
1	4,05	44,99	44,99	3,64	40,46	40,46	2,08	23,09	23,09
2	1,34	14,88	59,87	0,96	10,64	51,10	1,69	18,76	41,84
3	1,01	11,19	71,07	0,67	7,44	58,54	1,50	16,70	58,54

4	0,66	7,28	78,35						
5	0,61	6,75	85,10						
6	0,40	4,48	89,58						
7	0,34	3,75	93,32						
8	0,32	3,55	96,87						
9	0,28	3,13	100,00						
Extraction Method: Principal Axis Factoring.									

Rotated factor loadings represent how variables are weighted for each factor and correlation between the factor and variables. Correlations that are 0.4 or less are not printed because those probably are not meaningful and the output is clearer. Table 4 shows how rotated PAF factor matrix displays the item loading: past construction materials, past composites, past nanocellulose, past biofuels indicates products; past service enhancements, past brand development, past new marketing channels points to business innovation; past reducing environmental impacts of forestry and past reducing environmental impacts of manufacturing refers to sustainability. The output supports the theory of three-dimensional innovation. The factors of this solution were labeled as Product innovation (F1), Business model innovation (F2) and Sustainable innovation (F3).

Table 8 The rotated PAF factor matrix

Rotated Factor Matrix			
	Factor		
	1	2	3
past_construction materials	0.75		
past_composites	0.73		
past_nanocellulose	0.69		
past_biofuels	0.49		
past_service enhancements		0.54	
past_brand development		0.60	
past_new marketing channels		0.89	
past_reducing environmental impacts of forestry			0.73
past_reducing environmental impacts of manufacturing			0.77
Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			

After acquiring the three-dimensional factor solution, the respondent answers were saved via factor scores into the new factor coordinate system. Via this analyzing whether respondent exposure, involvement or other background factors would have an association with the views on bioeconomy innovativeness in one or more of the dimensions of innovation. Thus, next we analyzed the factor scores variables of different respondent groups via ANOVA- analysis.

AGE

Respondents who belong to age group 21-41 years felt that since year 2000 bioeconomy had done significantly (p=0,02) more business model/service innovations than over 63 years old respondents.

Table 9 Multiple Comparisons, Age groups

Multiple Comparisons							
Dependent Variable:	REGR factor BUSINESSMODEL						
(I) Gen Age Groups			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	below 20 years	21-41 years	0.53	0.36	0.14	-0.17	1.24
		42-62 years	0.14	0.38	0.71	-0.62	0.91
		over 63 years	-0.27	0.46	0.56	-1.18	0.64
	21-41 years	below 20 years	-0.53	0.36	0.14	-1.24	0.17
		42-62 years	-0.39	0.22	0.08	-0.82	0.05
		over 63 years	.805*	0.34	0.02	-1.47	-0.14
	42-62 years	below 20 years	-0.14	0.38	0.71	-0.91	0.62
		21-41 years	0.39	0.22	0.08	-0.05	0.82
		over 63 years	-0.42	0.36	0.26	-1.14	0.31
	over 63 years	below 20 years	0.27	0.46	0.56	-0.64	1.18
		21-41 years	.805*	0.34	0.02	0.14	1.47
		42-62 years	0.42	0.36	0.26	-0.31	1.14

*. The mean difference is significant at the 0.05 level.

GENDER

Women felt more often than men that there were significantly (p=0.01) more business model innovations in forest sector.

Table 10 ANOVA

ANOVA					
REGR factor BUSINESSMODEL					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.02	1.00	5.02	6.26	0.01
Within Groups	73.82	92.00	0.80		
Total	78.84	93.00			

PLACE OF LIVING

Those living in suburban area felt that since year 2000 bio-economy had done significantly (p= 0.052) more product innovation than those living in the rural area.

Table 11 Multiple comparisons, Area of living

Multiple Comparisons							
Dependent Variable:	REGR factor PROD						
(I) Dg_area of living			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	City or urban area	Suburban area	0.48	0.28	0.09	-0.07	1.03
		Rural area	-0.09	0.19	0.66	-0.47	0.29
	Suburban area	City or urban area	-0.48	0.28	0.09	-1.03	0.07
		Rural area	-0.56	0.29	0.05	-1.13	0.01
	Rural area	City or urban area	0.09	0.19	0.66	-0.29	0.47

		Subur-ban area	0.56	0.29	0.05	-0.01	1.13

PURCHASING WOOD PRODUCTS

Exposure to bio-economy was measured through consumption habits and through purchasing habits; how often respondents had purchased new wood based materials, composite materials made of wood or paper, biofuels made from forest resources or consumed wood construction services, nature tourism and recreation services, forest and landscape management services. Significant differences were found when comparing respondents who had purchased wood based materials and respondents who had purchased forest and landscape management services. Those who had purchased new wood based material more than 6 times a year felt there were significantly (P=0.02 and 0.002 and 0.02 and 0.00) more product innovations than other groups. Those who had purchased forest and landscape management services 1 to 2 times a year considered there were significantly (p=0.02 and 0.03 and 0.02 and 0.00) more sustainable innovations than other groups.

Table 12 Multiple Comparisons, Purchasing new wood based materials

Multiple Comparisons							
Dependent Variable:	REGR factor PROD						
(I) purchasing_new wood based materials			Mean Diffe-rence (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Never	Less than once a year	-0.40	0.25	0.11	-0.89	0.0928926
		1 to 2 times a year	0.03	0.27	0.92	-0.50	0.56
		3 to 6 times a year	-0.55	0.40	0.18	-1.36	0.25
		More than 6 times a year	1.27*	0.53	0.02	0.20	2.33
	Less than once a year	Never	0.40	0.25	0.11	-0.09	0.89
		1 to 2 times a year	0.43	0.22	0.06	-0.02	0.87
		3 to 6 times a year	-0.15	0.38	0.69	-0.91	0.60
		More than 6 times a year	1.67*	0.52	0.00	0.64	2.69
	1 to 2 times a year	Never	-0.03	0.27	0.92	-0.56	0.50
		Less than once a year	-0.43	0.22	0.06	-0.87	0.02
		3 to 6 times a year	-0.58	0.39	0.14	-1.36	0.19
		More than 6 times a year	1.24*	0.52	0.02	0.20	2.28
	3 to 6 times a year	Never	0.55	0.40	0.18	-0.25	1.36
		Less than once a year	0.15	0.38	0.69	-0.60	0.91
		1 to 2 times a year	0.58	0.39	0.14	-0.19	1.36
		More than 6 times a year	1.82*	0.61	0.00	0.62	3.03
	More than 6 times a year	Never	-1.27	0.53	0.02	-2.33	-0.20
		Less than once a year	-1.67	0.52	0.00	-2.69	-0.64
		1 to 2 times a year	-1.24	0.52	0.02	-2.28	-0.20
		3 to 6 times a year	-1.82	0.61	0.00	-3.03	-0.62

Table 13 Multiple comparisons purchasing forest and landscape management services

Multiple Comparisons							
Dependent Variable:	REGR factor SUSTAINABLE						
(I) purchasing_forest and landscape management services			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Never	Less than once a year	-0.06	0.25	0.80	-0.55	0.43
		1 to 2 times a year	.60*	0.25	0.02	0.11	1.09
		3 to 6 times a year	-0.24	0.30	0.42	-0.84	0.36
		More than 6 times a year	-0.60	0.36	0.10	-1.31	0.12
	Less than once a year	Never	0.06	0.25	0.80	-0.43	0.55
		1 to 2 times a year	.66*	0.30	0.03	0.06	1.27
		3 to 6 times a year	-0.18	0.35	0.61	-0.87	0.51
		More than 6 times a year	-0.54	0.40	0.18	-1.33	0.26
	1 to 2 times a year	Never	-0.60	0.25	0.02	-1.09	-0.11
		Less than once a year	-0.66	0.30	0.03	-1.27	-0.06
		3 to 6 times a year	-0.84	0.35	0.02	-1.54	-0.15
		More than 6 times a year	-1.20	0.40	0.00	-2.00	-0.41
	3 to 6 times a year	Never	0.24	0.30	0.42	-0.36	0.84
		Less than once a year	0.18	0.35	0.61	-0.51	0.87
		1 to 2 times a year	.84*	0.35	0.02	0.15	1.54
		More than 6 times a year	-0.35	0.44	0.42	-1.22	0.51
	More than 6 times a year	Never	0.60	0.36	0.10	-0.12	1.31
		Less than once a year	0.54	0.40	0.18	-0.26	1.33
		1 to 2 times a year	1.20*	0.40	0.00	0.41	2.00
		3 to 6 times a year	0.35	0.44	0.42	-0.51	1.22

Concluding the results acquired, it seems that the citizens' awareness of forest sector and its innovations is fragmented and tenuous, which causes that the public image of forest sector innovativeness since year 2000 across four European forest rich coun-

tries is not generally perceived as promising as it is perceived among industry itself. For instance, on a contrary to forest industry's enthusiasms towards nanocellulose, about 40 % of the respondents were not aware of nanocelluloce and its possibilities.

6.2 MANAGERS VIEWS ON INDUSTRY'S CONTRIBUTIONS TO SUSTAINABLE INNOVATIONS

This chapter presents how forest industry professionals see forest industry contributions to sustainable innovations through the lens of three-dimensional innovation model/pyramid. Furthermore, the aim was to get some reflections from survey results presented previously in this study. The results were presented to bio-economy professionals and by using theme interview some comments regarding survey results and innovation model proposals/improvements was indicated. Interview themes were following:

- Three-dimensional innovation categorization
- Product-, service- and sustainability innovations' significance to business
- Investing in innovation activities
- The future of forest sector and sustainable innovation activities in forest bioeconomy
- Sustainable development as a part of innovation activity

6.2.1 Three-dimensional innovation categorization

About the innovation categorization some of forest bioeconomy professionals agreed but also some new ideas came forth. It was suggested that instead of "Nanosellulose" there should be "Biochemicals". It was pointed out that nanosellulose belongs into biochemicals and is just one example of biochemicals; biochemicals can be also lignin-based products, and not only nanosellulose-based. Interviewee suggested that the concept of biofuels could be reconsidered because biofuels necessarily are not forest based, it can be produced as a side product or by burning products that are at the end of their lifecycle. Thus, the term "Biofuels" could be reasonable to change into "Bioenergy" because energy is wider concept and includes fuels and

biomass energy. It was also pointed out that textiles and fibres were entirely missing from innovation pyramid and could be added as its own part:
"*One important thing missing from the categorization is viscose cellulose, in other words replacing cotton. Viscose cellulose is connected to clothing manufacturing, as cotton production is one of the world's environmental problems. That is why fibres/textiles could be added there.*"

In addition to that, it was suggested that in sustainability innovations the carbon neutrality/storage features of wood products could be somehow emphasized. Moreover, headline "Business model /service innovation" is quite harshly simplified from the bioeconomy professionals' opinion. It was questioned whether it is a good idea to put those together because in some business areas service aspect is not suitable or reasonable to use and business model itself can be considered as innovation without any service lens. According one opinion bioeconomy should be seen as a combination of business model and product innovation, some cases with the service included and some cases not included. Further it was suggested that in bioeconomy the essential idea is that business innovation, product innovation and sustainability are all integrated with each other:
"In my opinion business and product innovation and bioeconomy, sustainability.. Those are strongly linked into each other; they have to go hand by hand because it doesn't fly without that"

6.2.2 Product-, service- and sustainability innovations' significance to business

It was asked forest bioeconomy **professionals to evaluate the significance of product, service and business innovations** to bioeconomy and forest sector business. Some comments underlined that product and service innovations goes alongside (service aspects for example such as product safety, aftersales and lifecycle assessments). Entities are and will be important, usage and lifecycle aspects are emphasized; it was mentioned that for example climate change, carbon mitigation and regulations would have affect to demand of construction materials.

According to interviewee, in the future forest-based bioeconomy should focus on improving commercializing; now there is a lack of commercializing and focus is too much on technical issues:

" In the past technical and natural science knowledge has been appreciated, which is extremely important, but it has been over appreciated by the expense of commercial knowledge. It has been thought that if we make a good product, everyone can sell it but now we know it is not the case… it is easier to control technical side because it depends on what you do but commercial side is more difficult as you have to get others to become excited as well."

It was pointed out that brand evolvement and marketing should to be improved because new product or innovation is useless if there are no customers – the whole value chain, customer and consumption must be there. In addition, it was stated that providing technical solutions to (potential) customers, for example user guidance/support and manuals will be more important than before.

6.2.3 Investing in innovation activities

In the context of investing in innovation activities, there were large amount of "I don't know" answers regarding questions of nanocellulose in W3B survey results, which implies that the respondents found it difficult to comprehend nanocellulose. According to bioeconomy professionals the reason is in nanocellulose's nature: it is not so tangible as for example wood (desing) furniture or constructions, which are seen in everyday life (magazines, cities, furniture stores etc.) It was pointed out that in professional magazines nanocellulose has been occurring in discussions but maybe because commercial breakthroughs and applications are missing, consumers and citizens do not see it. It was indicated that in industrial applications nanocellulose is broadly used but it cannot be seen, so people do not realize it has been used. It was suggested that maybe because technical factors are underlined more than commercial things, nanocellulose and its use in different applications hidden for the citizens.

The survey respondents also considered that it is not necessary to put more efforts on biofuels in the future, which was a surprising result for bioeconomy professionals due the constricting regulations and renewable energy targets of European Union.

The reasons for the result was estimated to ascribe from that biofuels were perhaps understood to be just fuels, not fuels made as sideproduct. Also, it was suggested that possible rise in electric car's amount and usage may cause the feeling that fuels are less important and not worth new innovation efforts.

According to survey results, brand development in forest sector could have had more efforts from the year 2000. In general, managerial interviewees saw that in last 10 years the change towards bioeconomy has been done and also brand development alongside. It was pointed out that mostly business in forest sector has been b2b not with the consumer, which causes that consumer products or services has not been branded.

6.2.4 The future of forest sector and sustainable innovation activities in forest bioeconomy

It was stated that stakeholder groups are emphasized differently in different business areas and it will have effects on innovation activities, for example tax incentives and charity actions are quite different in North American and in European companies. One point suggested that laws and regulations partly have caused that and therefore it is important to have dialogue with legislation and government - sometimes new innovations for example in construction business are hard or impossible to provide to customers because old legislation is not aware current features of wood based products. According to interviewee, regulations and legislation should be evolved alongside with wood products. In addition, it was suggested that customers should be taken along to research and development (R&D) actions so that their needs and opinions can be considered at the early stage of a development process. One opinion was that information distribution towards citizens and popular movements could help to prevent misunderstanding, for example defending bioenergy can be caused of bad and incomplete information of what does bioenergy/fuels consists (it is not just burning wood/forests).

Forest bioeconomy professionals' opinions about most important drivers for innovation in forest bioeconomy were diverse. One statement was that getting closer to users and user-friendly products/solutions/services could be perceived as a driver, and

the user-friendliness could imitate IT/mobile sector success stories in that area. It was stated that drivers for innovations are sorted according to maturity of the business, for example in paper branch effectiveness and cost savings are the innovation drivers. It was suggested that replacing none renewable materials and fossil materials with renewable materials is one big societal driver for forest bioeconomy, and wood is a unique material for that. It was noted that forest owner's customer service has recently become more important than before and sector companies are clearly putting more effort on that. It was claimed that in the forest sector's future increasing and gaining business with new products and business area is necessary and thus it is one of a key drivers for innovations. Lifecycle thinking and decreasing carbon footprint were as well mentioned for innovation drivers in forest sector:

"Our customers have to recognize different steps of construction activities and the usage of buildings; the biggest effect regarding buildings usage comes from energy consumption, in other words heating and lightning has the biggest impact through its lifecycle. Now the regulations of construction are evolving and every building should be almost 0 energy house, the climate impact of usage decreases and thus material used in buildings have bigger emphasis while estimating buildings carbon impact due its lifecycle."

"Customers should be able to decrease their operative carbon footprint and by using wood, it is possible"

Also health impacts of wood and product safety were mentioned to be good advantages when providing products to replace competing materials. It was pointed out that there are challenges in innovation activities strengthening efforts, for example getting a product through the whole value chain is very slow, it usually takes 4-7years. Furthermore, from innovation point of view 20 years is really rapid but from marketing view, it is considerable time away and that maybe one reason why innovations and marketing are sometimes hard to combine. Co-operation was perceived to be important; because new areas are difficult to comprehend, it is necessary to do co-operation within the forest sector and with external professionals. Political environment was held to be important for innovation activities as it can have various impacts to business. It was mentioned that creating and finding the whole value chain, which is essential for new innovative product to success, can be arduous. It was pointed out

that time and geographical standpoints should be thought in products, which is difficult because the norms, for example regarding recycling materials, vary in different time and countries. One interviewee underlined the importance of the time span and explained that it is hard to vision the world and infrastructure in the future and where does circular economy work if not all over the world.

It was argued by an interviewee that in material technology totally new innovations, which are new to the company itself as well as to the world, it takes long time to build the infrastructure needed. It was pointed out that in forest sector, it takes enormous work to get some new matters visible among traditional and paper business. According to an interview, there are quite few spin offs and start ups in forest bioeconomy because the ecosystem consists merely from large forest companies due the business' high capital intensity and constructing a factory can take hundreds of millions - it was suggested that that is why there are internal start ups in large forest companies.

The biggest change in forest bioeconomy was suggested to be that the range of products will be much wider in the future. Interviewees seemed to believe that there will be more products, items, or utilizations, which yield more value. Biochemichals, textiles and clothes, biorefineries, replacing fossil materials with wood, replacing cotton with less water demanding cellulose -based textiles, packaging and hygiene products were mentioned as an example of what will the future of forest bioeconomy consists of. CSR was considered to be as a part of the current business idea of the forest bioeconomy where the products themselves are communicating about CSR and sustainability:

"Sustainability is a part of our business idea, in other words what we produce, from what and how and what kind of life cycle; there has to be sense in the context of sustainability, then it is a good business idea. If it would have a conflict with it, it would not be so good"

6.2.5 Sustainable development as a part of forest sector innovativeness

Interviewees talked much about lifecycle assessment and ecodesign. It was stated that currently not only the quality systems such as ISO –standards are important but also the whole lifecycle of the product should be and is considered in innovation activities. Lifecycle assessment is important according to interviewees because it is easier to take problems and aberrations into account and make remedial actions at the early stage than later along the process. It was suggested that it is not enough that the product is made from renewable material; carbon footprints must be smaller in the whole process, in operations and with current use because more over to environmental benefits, often mitigating carbon footprint can engender economic advantage to not only the company itself but to the customer also. It was mentioned that producing economic advantage to customers through sustainable innovations can be considered as a target and same time it is sustainable environmentally. One given example pointed out that if trying to replace fossil fuels it should be thought where fossil fuels are used and how co2 emissions can be reduced and how resource efficiency can be accomplished.

Product safety was considered to be important and wood as a material suits well for multiple kinds of usages. As well as health effects of wood buildings and furniture were mentioned as a related thing to product safety issues, for example there has been interest towards public schools made of wood.

Importance of owning forest and the whole value-chain related to it can be thought as a part of sustainability according to an interviewee. Forests' role as a source of well-being and incomes was suggested to be as a part of sustainable innovation activities; forests are sustainable source of incomes. It was pointed out that all kinds of social questions related to communities are important, not only the employees or partners and when thinking for example wood constructions, it is kind of a social question when providing sustainable wood buildings and –cities, sustainable living solutions and sustainable bioenergy for heating for society. More over, the new business idea of forest bioeconomy was presented to come from the aim to provide sustainable

products for sustainable living and for example energy and residency are two quite major areas in human life:

"If we think about wood products, building and energy, don't those have quite big role while building communities, in other words wood constructions, cities, sustainable living and using bioenergy for heating… two quite large sectors, which people need everyday. You need residence and energy everyday. Sustainable products for sustainable living are the business idea. Residency and energy production."

Innovation aspects and sustainability issues emerged in managerial interviews and by using content analysis it was possible to have individual professional observations related to product-, business-, and sustainability innovation categories. Those were grouped into relevant categories according the three- dimensional innovation model and after that some benefits and challenges were identified (see Table 14).

Table 14 Managerial aspects on future forest bioeconomy innovations

Products	**Benefits**	**Challenges**
Biochemicals	More value	Existance/understansdability to consumers
Wood construction materials and solutions	More value to the customer	Service aspect unreasonable in some cases
Biofuels (energy) from sideproducts	Resource efficiency	Delivery/availability
Fibres and textiles	Replacing cotton (-> smaller environmental footprint)	Cost effectiveness
Hygiene products and packaking materials	Replacing fossil materials	Some limitations for example shelf life in groceries packages
Business	**Benefits**	**Challenges**
Heterogenity of wood products in the future	New bussiness opportunities	Lack of commercialising (focusing too much on technical issues)
Multidimensional stakeholder groups	Varying views and innovation inputs	Depends the stage of product maturity
Providing economic benefit to customers	Economic advantage from the usage of wood based products	Setting the price right (in comparison to fossil material)
Marketing and public awareness	Technology add-on's	20 years is soon for innovation but a lifetime for commercial
Sustainability	**Benefits**	**Challenges**
Lifecycle and ecodesign	LCA instead of ISO etc standards	Long value chains
Carbon neutrality, emission mitigation	Carbon storage with wood	Marketing and public awareness
Product safety	Health impacts	Regulations and incentives unfavourable
Forests' role as a source of livelihood	Providing sustainable life: habitation and energy	Innovation drivers vary according maturity of the busines sarea

7 DISCUSSION AND CONCLUSIONS

7.1 Reflections on Research Questions and Theoretical Framework

The main objective of this study was to investigate how do citizens perceive the forest industry companies' innovativeness from the point of sustainability. Due to the increasing importance of bioeconomy in forest sector, it is valuable to examine how new and old forest sector products are perceived from the point of citizens. In addition to that, sustainable innovations in forest bioeconomy have grown and will grow more essential due the effects of global megatrends. One major challenge is, that it has been difficult to define and adduce the meaning and possibilities of sustainable innovations in forest bioeconomy the way that citizens would understand and recognize.

The findings of the W3B – Survey indicated that the public perceptions and knowledge of forest sector innovations is quite shattered (see also Stern et al. 2018). Regarding past innovation efforts the public opinion of forest sector innovations seemed to focus on constructions related innovation efforts and biofuels. In addition, results showed that perceptions of material substitution with wood and reducing environmental impacts of industry were improved since year 2000. The image of future innovation targets of forest sector were quite wide put most heavily it was pointed towards wood building systems, construction materials, brand development and material substitution with wood. Perhaps the most interesting finding was that on a contrary to forest industry's enthusiasm towards nanocellulose, very few of the respondents were not aware of nanocelluloce and its possibilities. Statistically significant differences found between the "past" and "future" innovativeness call for strengthening of both industry R & D and functioning of innovation systems.

Current state of forest industry and its innovations possibilities are perceived to be in more traditional areas such as construction and wood building systems, maybe because those are more tangible than e.g. nanocellulose. Creative destruction of forest sector and strategic changes (such as shutting down paper machines) due to paper production decreasing seems to create the burden of history because industry's past

still seems to affect on citizen's perceptions of forest sector ability to reform and innovate. Brand development (could be included as a part of strategic development) was one of those areas that had biggest change when comparing W3B survey respondents' perceptions of past and future innovation efforts.

The framework and the literature review of this study consist of CSR, innovation theories, and forces affecting the forest sector change towards bioeconomy. In this study, survey results of citizens' perceptions on sustainable innovations in forest bioeconomy were viewed from the point of three-dimensional innovation pyramid (see picture 9). Stakeholder engagement theories were lightly involved due public perceptions is not only describing the image of forest sector but also what kind and how deep new innovation efforts the end-user has been exposed (see e.g. Vargo & Lusch 2008). Regarding the applicability of theoretical framework, it revealed to be a bit partial regarding the customer engagement theories. The relevance of subjects was found valid and in order to complement the framework, survey results were fitted into theoretical frame for the theme interviews of forest sector managers. Some parts of the theoretical framework were emphasized while forming the themes because it needed to be assessed according to survey results.

The secondary objective of this study was to identify how do corporate managers see industry contributions to sustainable innovations in comparison to citizens' perceptions. This was implemented by reflecting forest professionals' insights in comparison to Survey results. Moreover, the findings of the Managerial Interviews indicated benefits and challenges that the on-going change towards forest bioeconomy and more business model integrated CSR strategies have (See Picture 16 Managerial aspects of future forest bioeconomy innovations).

The interview results suggested that the three-dimensional innovation pyramid could be refined in some areas, for instance "Nanocellulose" could be better and more descriptive if it could be changed into "Biochemicals". Additionally the term "Biofuels" could be better as a wider concept "Bioenergy". Discussions regarding product-, service- and sustainability innovations' significance to current and future business indicated the need of commercializing and need of providing technical solutions to potential customers due the changing demand (with global megatrends and regula-

tions on the background). One of the most interesting recognition was that new product or innovation is useless if there are no customers – the whole value chain, customer and consumption must be there. Entities, the usage and lifecycle of a product are important and sometimes also have a service lens.

7.2 Limitations, implications and suggestions for future research

Critical evaluation of the results of this study reveals certain weaknesses and restrictions regarding reliability and validity. The survey's small sample size and the fact that sample is not representative of countries' populations restricts the generalization of results. Also, because of the biased results of socio-demographic description of the sample compared to population of the countries, it could be possible that the people who are somehow involved or interested with the sector responded the survey. Like Stern et al. (2018, p. 6) state "…it is assumed that some of those who participated in the survey did so for a specific reason, such as familiarity either with the topic, or the research institution. It likely attracted respondents interested in forestry and forest issues even when not formally involved in the sector." Thus, a recommendation for future research is to conduct a larger scale study in order to have less biased sample of the population. Moreover, the managerial interviews were only reflective and the number of the interviews was too small in order to get a comprehensive picture from forest industries' professionals' sights.

Regardless the limitations of this study, the finding of this study refers for strengthening R&D and improving innovation communication in order to raise citizens' awareness of new products and solutions in forest based bioeconomy. Due the maturing of traditional forest sector products, forest sector competitiveness is dependent on new innovation and differentiation strategies and cross-sectorial collaboration. Co-branding with some other industry could help increase the societal knowledge of forest sector companies, who mainly operate business-to-business.

Moreover, stakeholder engagement by getting them involved with the matter and as value co-creators could generate more user information, which would help in creating new business models and identify new opportunities. Customer value identification, whether it is sustainability, design, cost effectiveness or co-operation, could

have possibilities regarding new R&D actions. Business model development towards idea that “customers are customers even when not buying” could change the public opinion and perceptions of forest sector.

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Appendix 1. W3B Survey


Wood-based Innovations

Over the last few decades, growing environmental awareness and an increase in society's interest in topics related to sustainability have led to a greater focus on the forestry and wood sector. The increased interest and new demands are forcing this sector to clearly define its position and significance with regard to climate change, the supply of raw materials and the bio-economy, and to present these topics to the general public in a comprehensible manner.

Thank you for participating in the What We Wood Believe (W3B) project by completing the following questionnaire.

Participants from Austria, Finland and Germany will be given the opportunity to enter their e-mail and be entered into a drawing for a prize. Please note the prize will vary based on which region you are in.

There are 21 questions in this survey

Wood-based Innovations (1 of 2)

1 []Since the year 2000, forest sector companies have produced significant innovations related to... *

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	I don't know
Wood construction materials	○	○	○	○	○	○
Paper products	○	○	○	○	○	○
Composite materials fabricated with wood or paper materials	○	○	○	○	○	○
Nanocellulose	○	○	○	○	○	○
Biofuels made from forest resources	○	○	○	○	○	○
Service enhancements in forest management	○	○	○	○	○	○
Production processes	○	○	○	○	○	○
Material substitution with wood	○	○	○	○	○	○
Developing recognized brands	○	○	○	○	○	○
Developing or utilising new marketing channels	○	○	○	○	○	○
Reducing the environmental impacts of forestry	○	○	○	○	○	○
Reducing the environmental impacts of processing and manufacturing	○	○	○	○	○	○
Building systems with wood	○	○	○	○	○	○

2 []How often do you purchase the following forest sector products or services? *

Please choose the appropriate response for each item:

	Never	Less than once a year	1 to 2 times a year	3 to 6 times a year	More than 6 times a year	I don't know
New wood-based materials	○	○	○	○	○	○
Composite materials made of wood or paper	○	○	○	○	○	○
Biofuels made from forest resources	○	○	○	○	○	○
Wood construction services	○	○	○	○	○	○
Nature tourism and recreation services	○	○	○	○	○	○
Forest and landscape management services	○	○	○	○	○	○

Wood-based Innovations (2 of 2)

3 []For societal and sustainable development, I think the forest sector should focus their innovation efforts over the next 20 years on... *

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	I don't know
Wood construction materials	○	○	○	○	○	○
Paper products	○	○	○	○	○	○
Composite materials fabricated with wood or paper materials	○	○	○	○	○	○
Nanocellulose	○	○	○	○	○	○
Biofuels made from forest resources	○	○	○	○	○	○
Service enhancements in forest management	○	○	○	○	○	○
Production processes	○	○	○	○	○	○
Material substitution with wood	○	○	○	○	○	○
Developing recognized brands	○	○	○	○	○	○
Developing or utilising new marketing channels	○	○	○	○	○	○
Reducing the environmental impacts of forestry	○	○	○	○	○	○
Reducing the environmental impacts of processing and manufacturing	○	○	○	○	○	○
Building systems with wood	○	○	○	○	○	○

4 []How important are the following communication channels to you in learning about the wood-based innovations? *

Please choose the appropriate response for each item:

	Not at all important	Unimportant	Neither important nor unimportant	Important	Very important
Company webpages	○	○	○	○	○
Newspapers	○	○	○	○	○
Television	○	○	○	○	○
Social media	○	○	○	○	○
Regulators and authorities	○	○	○	○	○
Salesperson in the stores	○	○	○	○	○
Colleagues	○	○	○	○	○
Friends	○	○	○	○	○
Other	○	○	○	○	○

5 []Do you have any comments related to this topic? Please provide them below.

Please write your answer here:

General questions

6 []Please state your level of involvement with the forest based sector. *

Please choose **all** that apply:

- ☐ I am employed in the forest based sector directly
- ☐ I am employed in a field related to the forest based sector (e.g., construction, transportation, logistics)
- ☐ I have a formal education related to the forest based sector (e.g., currently enrolled, or past enrolment in a forest related field, e.g., wood science, forestry)
- ☐ I own a forest
- ☐ I am not involved with the forest based sector
- ☐ I have other involvement with the forest based sector: :

7 []Do you or your family receive any income from forestry and/or the forest based industry? *

Please choose **only one** of the following:

- ○ Yes
- ○ No

8 []What type of home is your primary residence? *

Please choose **only one** of the following:

- ○ Single family
- ○ Multi-family (1-4 residences)
- ○ Multi-family (5 or more residences)
- ○ Other

9 []What is the primary building material in your primary residence? *

Please choose **all** that apply:

- ☐ Steel
- ☐ Concrete
- ☐ Stone
- ☐ Wood
- ☐ Bricks
- ☐ I don't know
- ☐ Other: _____

10 []How did you learn about this questionnaire?

Please choose **only one** of the following:

- ○ School
- ○ Work
- ○ Friends or Family
- ○ Facebook
- ○ Twitter
- ○ Other social media
- ○ The W3B Website
- ○ Other _____

11 []On which topic(s) do you wish you had more information? *

Please choose **all** that apply:

- ☐ Efficient use of wood
- ☐ Building with wood
- ☐ Added value products
- ☐ Forest and Economy
- ☐ Forests and global warming
- ☐ Conservation by production
- ☐ Multifunctional forestry and forest ecosystems services
- ☐ Wood-based innovations
- ☐ I am satisfied with the current amount of information I currently have
- ☐ Other: _____

Demographics

12 []What is your age?

Only numbers may be entered in this field.

Please write your answer here:

years

13 []What is your sex?

Please choose **only one** of the following:

- Female
- Male

14 []What is your employment status?

Please choose **all** that apply:

- Employed for wages
- Self-employed
- Unemployed and looking for work
- Unemployed and not looking for work
- Homemaker
- Student
- Military
- Retired
- Unable to work
- Other:

15 []What is the highest level of education you have completed?

Please choose **all** that apply:

- ☐ Less than high school degree
- ☐ High school graduate, diploma or equivalent
- ☐ Trade, technical or vocational training
- ☐ Some college credit, no degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional degree
- ☐ Doctorate degree
- ☐ Other: _____

16 []I live in a:

Please choose **only one** of the following:

- ○ City or urban area
- ○ Suburban area
- ○ Rural area
- ○ Other _____

17 []I have lived most of my life in:

Please choose **only one** of the following:

- ○ Austria
- ○ Finland
- ○ Germany
- ○ Slovenia
- ○ Other _____

18 []I am originally from:

Please choose **only one** of the following:

- ○ Austria
- ○ Finland
- ○ Germany
- ○ Slovenia
- ○ Other

19 []I currently live in: *

Please choose **only one** of the following:

- ○ Austria
- ○ Finland
- ○ Germany
- ○ Slovenia
- ○ Other

20 []

Vielen Dank!

Sie haben gerade einen Fragebogen für das WoodBelieve Projekt ausgefüllt. Sie haben die Möglichkeit noch einen anderen Themenbereich zu beantworten.

Es besteht die Möglichkeit an einer Verlosung von vier Gutscheinen im Wert von jeweils 100,- EURO für einen Baumarkt teilzunehmen. Mit jedem Fragebogen erhöhen sich Ihre Gewinnchancen!

Wenn Sie an der Verlosung teilnehmen möchten, geben Sie bitte hier Ihre E-Mail-Adresse an.

Only answer this question if the following conditions are met:
Answer was 'Austria' *or* 'Germany' at question '19 [DGQ6]' (I currently live in:)

Please write your answer here:

21 [] If you wish to participate in a prize drawing... please enter your e-mail address to the spece bleow

Only answer this question if the following conditions are met:
Answer was 'Finland' at question '19 [DGQ6]' (I currently live in:)

Please write your answer here:

Appendix 2. Cover letter and theme question frame for managerial interviews

Hyvä vastaanottaja,

Biotalouden merkityksen korostuessa metsäsektorilla on tärkeä selvittää kuinka sekä uudet että vanhat tuotteet ja palvelut koetaan tavallisen kansalaisen näkökulmasta. Myös vastuullisuusinnovointi metsäbiotaloudessa on noussut ja noussee edelleen esiin globaalien megatrendien myötä, vaikkakin haasteena voidaan pitää sitä ettei vastuullisuusinnovoinnin merkitystä ja mahdollisuuksia metsäbiotaloudessa vielä täysin ole kyetty määrittelemään tai tuomaan esiin siten, että myös kansalaiset tiedostaisivat ne.

Tutkimusaineisto kansalaisten tulkinnoista liittyen metsäsektorin innovaatioihin ja vastuullisuuteen on kerätty online-kyselynä osana ERANET Wood Wisdom Net 'What We Wood Believe' (W3B) –projektia vuonna 2015 touko-elokuun aikana Itävallassa, Suomessa, Saksassa ja Sloveniassa. Linkki tutkimukseen lähetettiin sähköpostilistojen, sosiaalisen median sekä online-foorumien kautta tarkoituksena tavoittaa kansalaisia, joista osa on tekemisissä metsäsektorin kanssa ja osa ei. Vastaajia tässä kyselyssä oli yhteensä 218 henkeä.

Pyytäisin Teitä osallistumaan tutkimukseni toiseen vaiheeseen, jossa tarkoituksena on peilata W3B –kansalaiskyselystä saatuja tutkimustuloksia yritysvastuun ja tuotekehityksen parissa metsäsektorilla työskentelevien henkilöiden näkemyksiin. Haastattelussa ollaan kiinnostuneita yritysten näkemyksistä liittyen metsäteollisuuden innovaatiokykyyn sekä siihen vaikuttaviin tekijöihin. Lähetän ohessa koosteen kansalaiskyselyaineiston tuloksiin, jotta voimme keskustella tuloksista haastattelun yhteydessä. Voitte myös halutessanne tutustua haastatteluteemoihin ohessa. Haastattelut toteutetaan mahdollisuuksien mukaan joko Skype-puhelun avulla tai ennalta sovitussa paikassa (esimerkiksi yrityksenne tiloissa), siten että keskustelut nauhoitetaan. **Haastatteluaineistoa käsitellään ehdottoman luottamuksellisesti, haastateltavan henkilöllisyys tai edustamanne yritys eivät tule julkiseksi missään vaiheessa.**

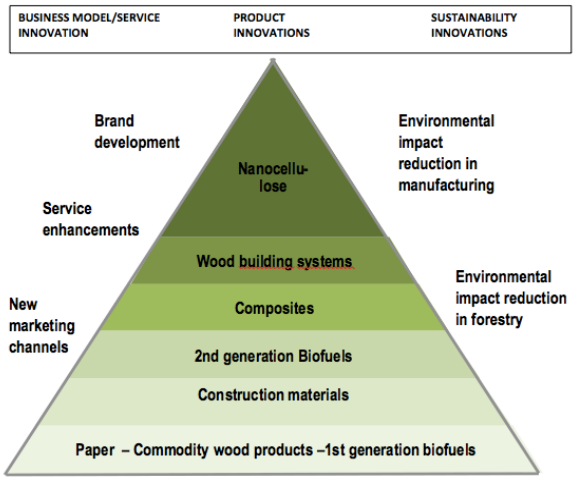
Tutkimus liittyy metsäekonomian ja markkinoinnin maisteriopintoihini ja pro gradu tutkielmaani Helsingin yliopistossa metsätieteiden laitoksella. Tutkimusta ohjaavat professori, MMT Anne Toppinen (puh. 050-4150219) sekä professori, MMT Katja Lähtinen. Tutkimuksen valmistuttua teidän on halutessanne mahdollista saada kopio opinnäytteestä.

Ystävällisin terveisin,

Monika Vihakara

0400-567527

Tuloksissa mainitut metsäsektorin tuotteet ja palvelut voidaan jaotella innovaatioryhmiin (tuoteinnovaatiot, liiketoiminta/palveluinnovaatiot, vastuullisuusinnovaatiot) seuraavan mallin avulla:



Kuva 1 Työ- ja elinkeinoministeriö, 2011

Metsäsektorin innovaatiot W3B-tutkimusaineistoon pohjautuen:

- Puurakentamisen materiaalit
- Paperituotteet
- Komposiitit puu- tai paperimateriaaleista
- Nanoselluloosa
- Biopolttoaineet metsästä

TUOTEINNOVAATIOT

- Palveluiden parannukset metsänhoidossa
- Tuotantoprosessit
- Materiaalien korvaaminen puulla
- Tunnistettavien brändien kehittäminen
- Uusien markkinointikanavien kehittäminen tai hyödyntäminen

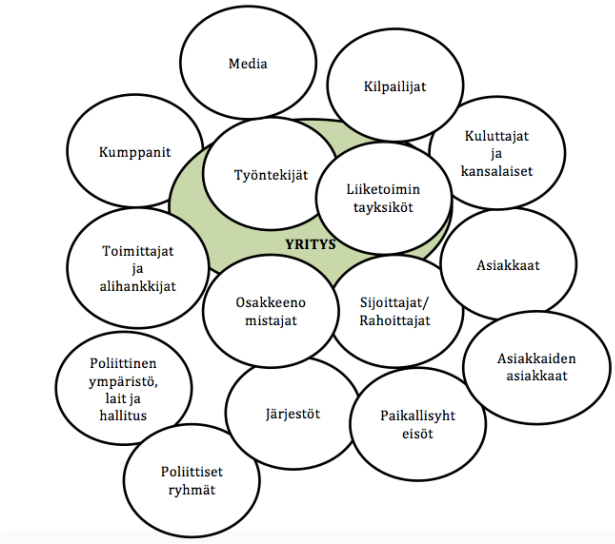
LIIKETOIMINTA-/PALVELUINNOVAATIOT

- Metsänhoidon ympäristövaikutusten vähentäminen
- Tuotannon ja prosessien ympäristövaikutusten vähentäminen
- Systeemien rakentaminen puusta

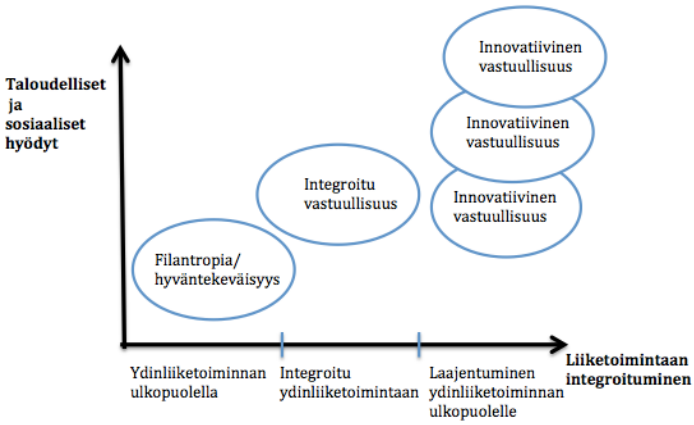
VASTUULLISUUSINNOVAATIOT

HAASTATTELUN TEEMAT

1. Tutkimustuloksien peilaaminen: Mitä mieltä olette kuvan 1 mukaisesta innovaatioiden jaottelusta? Puuttuuko jotain olennaista? Onko jotain turhaa mukana?
2. Tutkimustuloksien peilaaminen: Mitä mieltä olette jaottelusta tuote-, palvelu- ja vastuullisuusinnovaatioihin? Mikä ryhmä niistä on tärkein/vähiten tärkein omalle yrityksellenne ajatellen 15 seuraavan vuoden aikajaksoa?
3. Tutkimustuloksien peilaaminen: Tutkimustulosten kommentointi ja näkemyksiä: Onko tuloksissa jotakin yllättävää? Oletteko samaa/eri mieltä mieltä kansalaisten kanssa innovaatioihin panostamisesta? Miksi?
4. Innovaatiotoiminnan kehittäminen biotalouden ekosysteemeissä:
    a. Mikä on mielestänne eri osapuolten rooli ja työnjako? Onko tässä ongelmia?
    b. Mitkä ovat tärkeimmät ajurit innovaatioille metsäsektorilla? (kolme tärkeintä)
    c. Mitä haasteita liittyy mielestänne metsäsektorin innovaatiotoiminnan vahvistamiselle?
    d. Mikä on mielestänne suurin muutos joka tulee tapahtumaan metsäteollisuuden markkinoilla vuoteen 2030 mennessä?
5. Miten näette kestävän kehityksen olevan osa innovaatiotoimintaanne (ks myös kuva 3)? Vaikuttavatko yritysvastuun/kestävän kehityksen periaatteet innovaatiotoiminnan kehittämiseen? Miten?



Kuva 2 Yrityksen sidosryhmät



Kuva 3 Yritysvastuun ja ydinliiketoiminnan integraatio (mukaillen Halme & Laurila, 2009)